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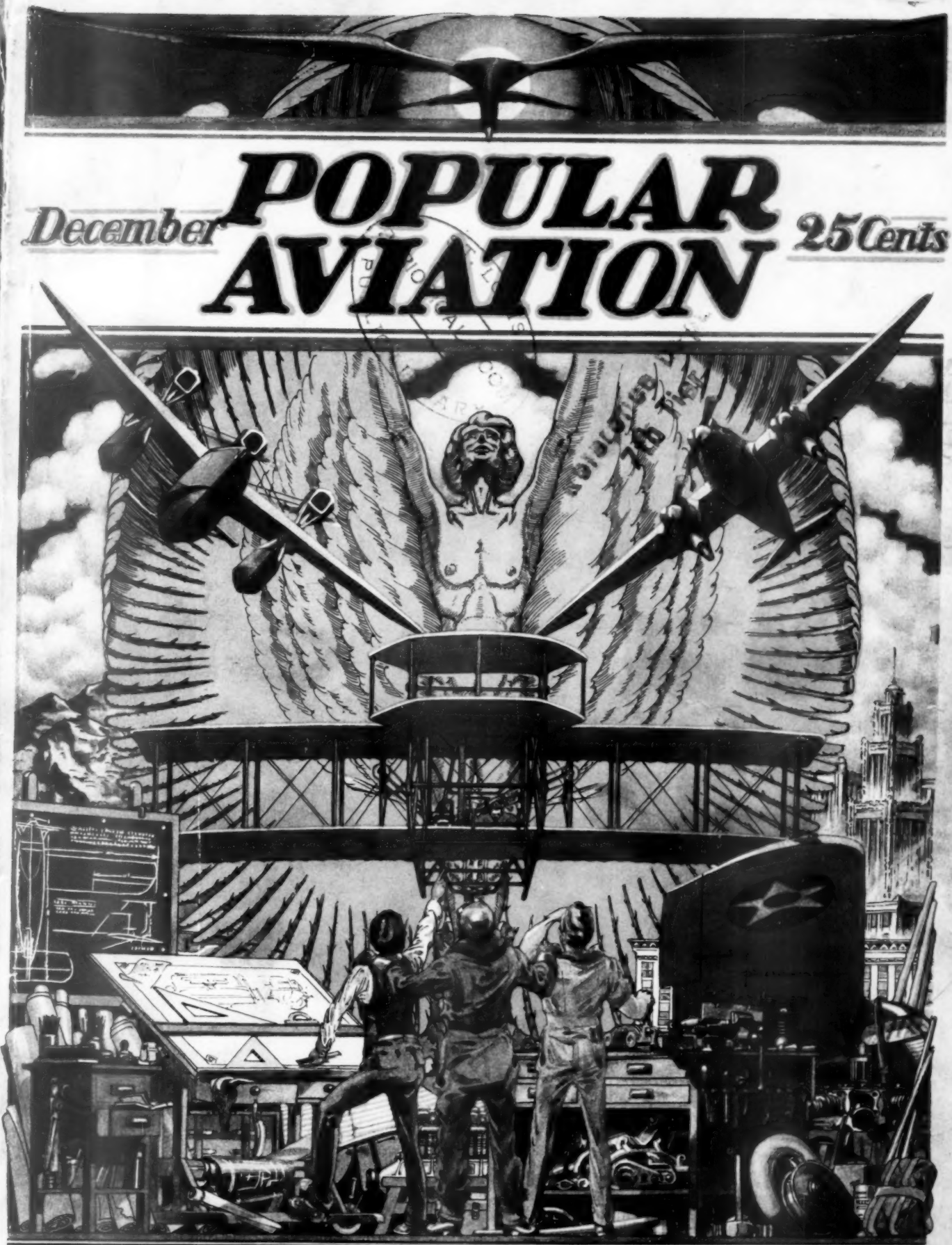

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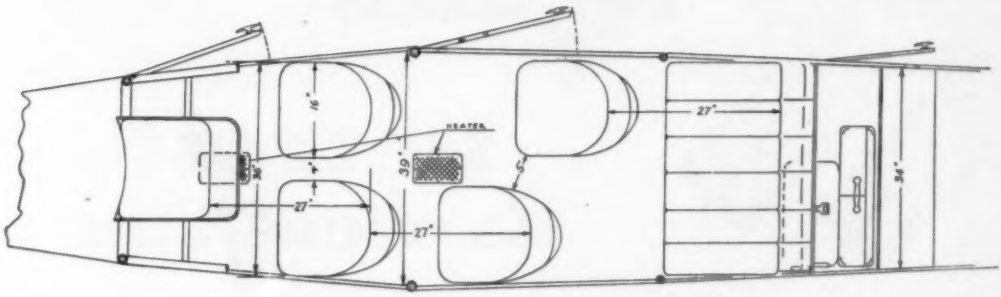

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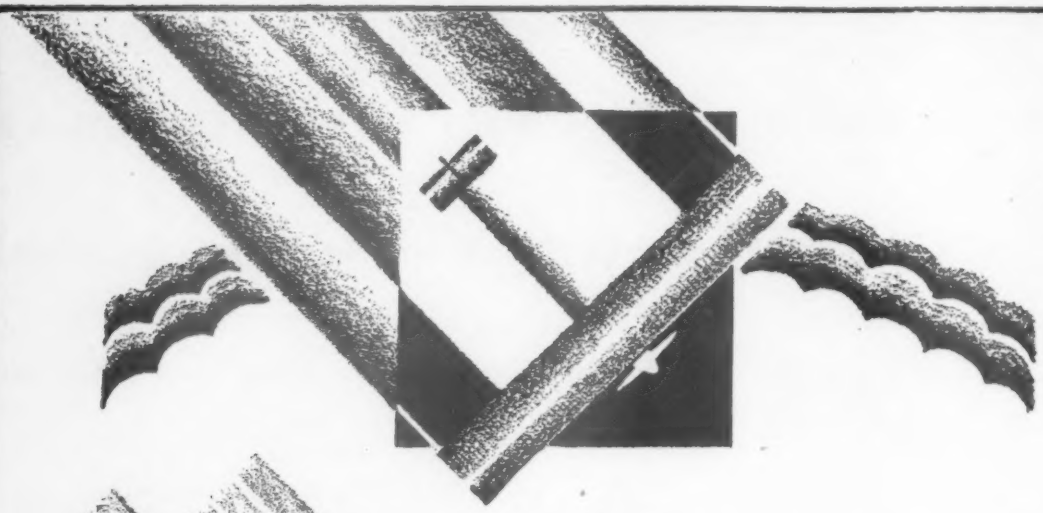

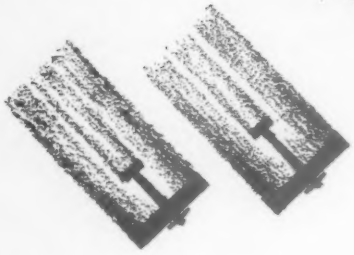

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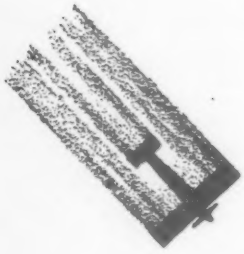

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Popular Aviation

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Orville Wright

Twenty-five years ago Orville Wright took off from a monorail on a Carolina sand dune on the world's first solo hop. Together with his brother Wilbur, Mr. Wright continued practicing, after the manner of all ambitious pilots, accumulating time in the air. It is encouraging to consider that after more than a year of flying neither Orville Wright or his brother Wilbur had flown an hour, and that several strenuous months of flying still remained for both before either could have hoped to qualify for a private license under present regulations. A king, numbers of noblemen, and many officers and private individuals rode in the Wright planes before the Department of Commerce would have granted the brothers limited commercial licenses.

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Dedication

IN dedicating this issue of POPULAR AVIATION to Wilbur and Orville Wright we simply express again a sense of the indebtedness we all share to the men who made the third form of transportation possible. Our debt is not a light one. The Wright brothers achieved very greatly on man's behalf, but without man's assistance, and almost without his goodwill. Human ridicule was as much an obstacle to the success of the Wrights as were the far less unfriendly natural laws which had always kept man on the ground.

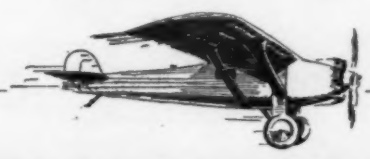
It is important, if we are to estimate with any accuracy the value involved, to remember exactly how much the Wrights had to overcome before mechanical flight could be made available to the world. The aerodynamic data of 1900 was not only fragmentary and limited, but was very largely false. As the Wright brothers continued their investigations they were forced to see more and more clearly that nothing had been proved a fact in the field of aeronautics. At the very beginning of their serious experimentation they were compelled to discard almost altogether the records of other workers and to rely on their own research as a basis for their studies.

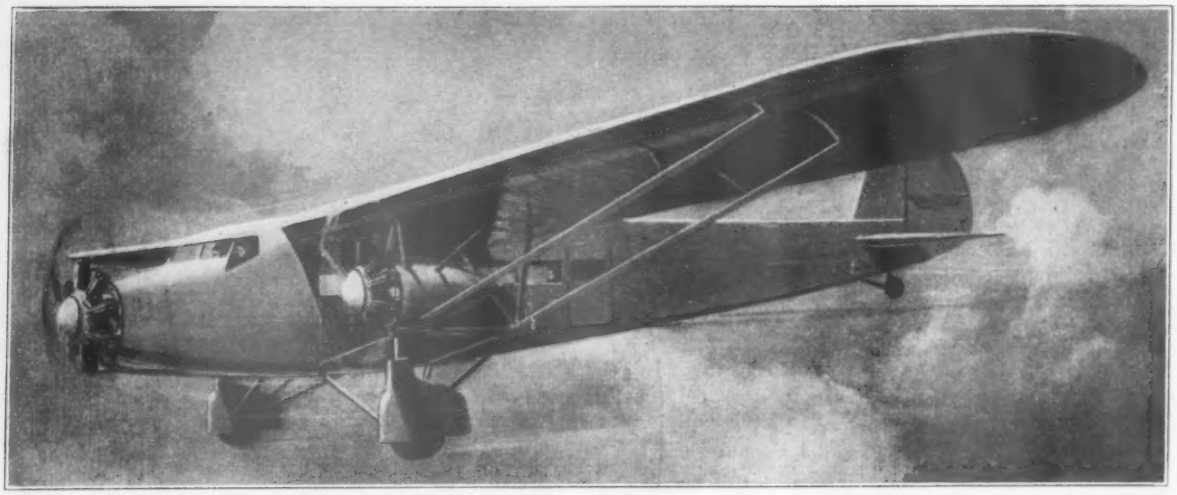
Besides having to master the unknown but fundamental facts of aerodynamics, the brothers had to design a controllable device that would sustain itself in the air with a pilot. They had also to design the propeller, or air screw, and they had to plan and construct an engine lighter, in relation to the horsepower it must produce, than any that had yet been developed.

The genius of the Wright brothers consisted in their ability to carry out original research along four distinct lines, and to combine the results of their thinking into a practical, working airplane.

Further changes and improvements have enlarged the capacity of the airplane for doing its work, and have increased its safety. Structural failures are rare, and very generally avoidable in the cases where they do occur; safety devices are being perfected and engines are constantly becoming more reliable. A generation is growing up which has no fear of traveling through the skies at speeds thought utterly fantastic only a few years ago.

The test of the greatness of any human invention or discovery is whether or not it makes man's life distinctly different and better. Judged on this scale the invention of the airplane ranks with the greatest discoveries of mankind. It has given us control over distance to an amazing degree. It has come to be thought of as a greater factor for peace than for war. It has opened a new world for man and has given us all a new and marvelous human experience.





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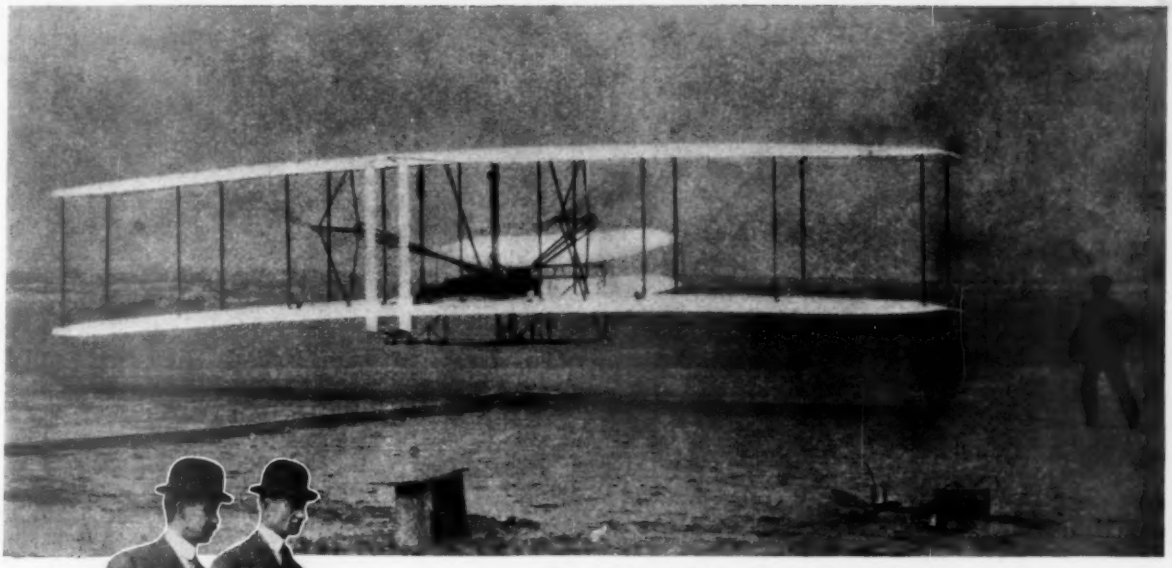


First flight at Kitty Hawk, Dec. 17, 1903

The Wright Brothers

IN December, 1901, the North American Review published an article by Rear Admiral George W. Melville, Engineer-in-Chief of the United States Navy, entitled "The Engineer and the Problem of Aerial Navigation." It is difficult today to believe that just twenty-seven years ago many of the best informed minds of the country were in practical agreement as to the total incompetency of man to fly. Nevertheless, Admiral Melville voiced the pessimism and skepticism common to the majority of his colleagues in engineering when he wrote:

"In earlier times many thoughtful men have given unqualified recognition to the uses and delights of the imagination. But could they see now, in the light of history, with what folly human nature has pushed a noble truth to the extreme, they would realize that much of its wisdom and grandeur has been obscured by the abuse of the imagination and undue revelling in its pleasures.

"This folly has been always peculiarly manifest in natural science, whence it penetrates to the field of applied mechanics.

"Outside of the proven impossible, there probably can be found no better example of the speculative tendency carrying man to the verge of the chimerical than in his attempts to imitate the birds, or no field where so much inventive seed has been sown with so little return as in the attempts of man to fly successfully through the air. Never, it would seem, has the human mind so persistently evaded the issue, begged the question, and 'wrangling resolutely with the facts,' insisted upon dreams being accepted as actual performance, as when there has been proclaimed time and again the proximate and perfect utility of the balloon or of the flying machine.

"Notwithstanding the amount of accurate physical knowledge now possessed by man, and the unremitting efforts on the part of many earnest investigators, pursuing methods of observation and experiment, who have within recent years placed the study of the problem of aerial navigation on a thoroughly scientific basis, it may be truly said that, so far as the hope of a commercial solution of the problem is concerned, man is today no nearer fulfillment than he was ages ago when he first dreamed of flying through the air."

And a little further on:

"The successful flying machine, to spring full-fledged from the ashes of present failure, would have to be a Phoenix."

Professor Simon Newcomb, in an article printed some three months earlier in McClure's Magazine, answered his own question, "Is the Airship Coming?" by pointing out certain laws of physics which seemed fatally opposed to human flight. He called attention to the fact that in any construction the weight is cubed as the size is doubled, while the surface area is merely squared. Dr. Newcomb continued:

"We may now see the kernel of the difficulty. If we had a metal so rigid and at the same time so light that a sheet of it twenty meters square and a millimeter thick would be as stiff as a board and would not weigh more than a ton, and at the same time so strong that a powerful engine could be built of it with little weight, we might hope for a flying machine which could carry a man. But as the case stands, the first successful flyer will be the handiwork of a watchmaker, and will carry nothing heavier than an insect. . . .

"I have shown that the construction of an aerial vehicle which could carry even a single man from place to place at pleasure requires the discovery of some new metal or some new force. Even with such a discovery, we could not expect one to do more than carry its owner.

Wright plane in the air at Fort Myer, during Government tests, 1908.

"Perhaps the main point I have tried to enforce in this paper is this —the very common and optimistic reply to objections, 'We have seen many wonders, therefore nothing is impossible,' is not a sound inference from experience when applied to a wonder long sought and never found."

While these articles were being written, Wilbur and Orville Wright were trying to make a kite that would carry a man. From 1878, when their father, Bishop Milton Wright of the Church of the United Brethren in Christ, had brought into their Dayton home a toy helicopter, the Wright brothers had been interested in the possibility of flying. They made small helicopters for themselves, and later on flew a great many kites. By and by they gave up kite-flying, feeling that they had outgrown this sport.

But in 1896 news of Otto Lilienthal's death in a gliding experiment reached the United States. The interest of the brothers was again aroused. They re-read Professor Marey's Animal Mechanism, and secured articles by Lilienthal and extracts from Mouillard's Empire of the Air (1881), in pamphlets published by the Smithsonian Institution. They also read Langley's Experiments in Aerodynamics (1891), and Story of Experiments in Mechanical Flight (1898), Chanute's Progress in Flying Machines (1894), and James Means' Aeronautical Annuals for 1895, 1896, and 1897.

The Wrights came to the conclusion that lack of actual practice in the air was the main reason for the failure of so many investigators to obtain satisfactory results. They found that Lilienthal, during five years of study, had been able to spend only about five hours in gliding through the air. They made up their minds that if some method could be developed to make possible longer practice periods in the air, there would be much more hope of solving the problem of flight. Accordingly, they determined to construct a machine which could be sustained at a speed of 18 miles per hour, and then go to some locality where winds of this velocity were usual. In effect, their plan was to practice flying in a large, stationary kite.

In October, 1900, the Wright brothers began active experimentation at Kitty Hawk, North Carolina. It was discovered that, in spite of testimony of existing air-pressure tables to the contrary, the design of their kite was faulty. The kite would not lift a man. Though disappointed, they rigged the kite with ground cables to the controls and operated it in this manner. Little flying experience was gained, but the opportunity to study and correct the control system was very worthwhile. Their system of balances proved to be effective, and the brothers went away encouraged by the season's work.

During the summer of 1901 the Wrights met Chanute. He spent several weeks as their guest at the camp near Kill Devil Hill in the next two years, but saw only one power flight, near Dayton, in October, 1904.

The machine used in 1901 had nearly twice the area of the previ-

Chatting about flying at Fort Myer (1908). Katharine Wright is at the extreme right.

ous one. It boasted 308 sq. ft., instead of 165 sq. ft. But even with this increase in size the plane proved inadequate to the task of lifting an operator. The plan of securing practice time in the air with a kite was abandoned, and the brothers turned their attention to gliding.

About two minutes of gliding had been accomplished in 1900. At the close of the season the glider had been given to Mr. and Mrs. Tate, at whose home the Wrights had stayed, and the fabric was already converted into dresses for the children. A second glider was built, and on July 27, 1901, it was flown with a pilot at Kill Devil Hill.

The 1901 season was a discouraging one, in spite of the fact that the brothers were able to glide with fair success. Practically all available aeronautical data had proved to be treacherous and uncertain. Several years later Wilbur Wright declared, " . . . when we left Kitty Hawk at the end of 1901 we doubted we would ever resume our experiments. . . . At this time I made the prediction that man would some time fly, but that it would not be within our lifetime."

The Wrights were at a critical point in their investigations. Until this period they had been making kites and gliders mostly for sport. Now they decided to place their work on a definite scientific basis, and in order to secure vital information concerning air currents, pressure, and the performance of different surfaces under different conditions, they constructed a wind tunnel at their shop in Dayton. Two testing machines were built. Preliminary measurements on nearly fifty different surfaces were tabulated at all angles from 0° to 45° at intervals of 2½°. It was discovered, among other things, that contrary to existing data, a square plane gave a greater pressure at 30° than at 45°. The Wrights were amazed, and doubted the accuracy of their own test. A weather vane was erected, with two planes attached to the pointer at an angle of 80° with each other. "According to our table," reads the Wrights' own account of this test, "such a vane would be in unstable equilibrium when pointing directly into the wind; for if by chance the wind should happen to strike one plane at 39° and the other at 41°, the plane with the smaller angle would have a greater pressure, and the pointer would be turned still farther out of the course of the wind until both vanes secured equal pressures at approximately 30° and 50°. But the vane did this very thing." Further corroboration of the tables was secured in actual experiments the next season.

In August, 1902, gliding was resumed at Kitty Hawk. The glider used in these experiments had at first a fixed vertical rudder aft of the wings, but by the end of the season the rudder had been made movable and had been attached to the wing-warping control, so that it turned towards whichever wing presented the smaller positive angle of incidence. This was the first application of the principle of obtaining lateral balance by adjusting wing tips and rudder to varying angles of incidence on the right and left sides.

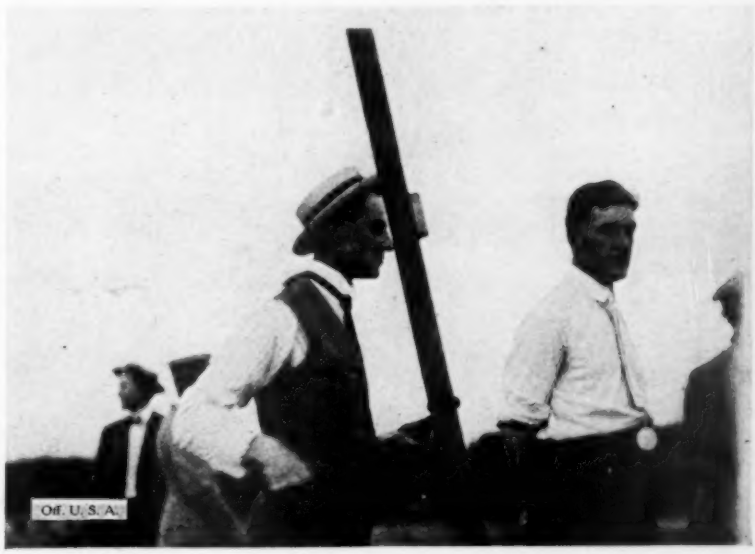
During September and October, 1902, nearly a thousand gliding flights were made, several of these covering a distance of more than 600 feet. Some were made against a wind of 36 miles per hour, and the Wrights felt more and more confidence in their system of controls. In August, 1903, flights of more than a minute were several times attained, and often one of the brothers would soar for a considerable time in one spot with no descent at all. One of their assistants hopefully suggested that all the glider needed was a coating of feathers to make it light enough to stay up indefinitely.

After three years of gliding the Wrights believed they possessed sufficient data to make a power flight possible. A patent was applied for, and the design and construction of a gasoline motor was undertaken. As usual, the Wright brothers did all the work themselves. The airplane was at first intended to fly a total weight of 600 lbs., including the pilot and an 8 h.p. motor, but when completed the motor gave more power than expected, so that an additional 150 lbs. of material was added to strengthen the machine.

Little difficulty had been anticipated in designing suitable propellers. The Wrights' tables made wing design a comparatively simple matter, and since screw propellers are after all merely wings traveling in a spiral course, the brothers expected to apply their wing formulae readily enough to this phase of the problem.

But, "What at first seemed a simple problem became more complex the longer we studied it. With the machine moving forward, the air flying backward, propellers turning sidewise, and nothing standing still, it seemed impossible to find a starting point from which to trace the various simultaneous reactions. Contemplation of it was confusing. After long arguments we often found ourselves in the ludicrous position of each having been converted to the other's side, with no more agreement than when the discussion began."

When the propeller riddle was finally solved, however, it was well solved. The first propellers produced, built entirely from calculations, gave in useful work 66% of



Wilbur Wright (left) at Fort Myer.

the power expended. This was about one-third again as much as had been secured by either Hudson Maxim or Prof. Langley.

The power glider was assembled at Kitty Hawk in November, 1903, and on the 17th of December the world's first power flights were made. Three days earlier the machine had been ready for trial, and a coin was tossed up to determine which of the brothers should make the first flight. Wilbur won, but the machine got away to a bad start. Before it had left the ground parts were broken. By the morning of the seventeenth it was again considered airworthy, and in a wind

Adjusting early Wright plane on monorail prior to take-off. Wilbur Wright is in his shirt-sleeves, at the left.

blowing 27 miles an hour, Orville Wright piloted the first airplane aloft. The flight lasted 12 seconds, and covered 120 feet from the end of the monorail. Wilbur Wright flew 12 seconds in the second attempt. Orville flew 15 seconds, and in the last flight of the day, Wilbur flew 59 seconds, landing 852 feet from the point of the take-off. A few minutes later the wind overturned the plane, which had been left temporarily unguarded, and several ribs were broken. The brothers had proved that their machine could fly and land under its own power in a winter wind. They packed up and went home.

The Norfolk *Virginia Pilot*, in its issue of December 18, 1903, ran a story under a 7-column head reading:

FLYING MACHINE SOARS 3 MILES IN TEETH OF HIGH WIND OVER SANDHILLS AND WAVES AT KITTY HAWK ON CAROLINA COAST.

The story was an imaginative description of the flights, based partly on gossip and partly on recollection of the three years of gliding trials. Local correspondents sent items to metropolitan newspapers, but if these were published at all they were given very inconspicuous positions.

But man could fly!

The Wrights carried on their experiments for the next two years at Simms' Station, near Dayton, in a field belonging to Torrence Huffman. Here a shed was erected and a new machine, similar to the first, but heavier and stronger, was built. Maintenance of equilibrium still gave trouble. By the end of September, 1905, after repeated experiments, this difficulty was very largely overcome. On October 5, 1905, experimentation was discontinued, owing to the crowds that were constantly at the field.

During 1904, 105 flights were made. These included the first turn, made by Orville Wright on the 15th of September, and the first circle, made by Wilbur Wright on the 20th. In 1905, more than 50 flights were made by the Wrights. Among these were the following:

September 26, 11⅛ miles in 18 minutes and 9 seconds by Wilbur Wright.

September 29, 12 miles in 19 minutes and 55 seconds by Orville Wright.

October 3, 15¼ miles in 25 minutes and 5 seconds by Orville Wright.

October 4, 20¾ miles in 33 minutes and 17 seconds by Orville Wright.

October 5, 24 1/5 miles in 38 minutes and 3 seconds by Wilbur Wright.

The average speed in these flights was about 38 miles an hour. During the three years of power flying some 160 flights were made, covering about 160 miles. It is interesting to note that the flight of October 5th, in which the flying field was circled thirty times, was longer than all the 105 flights of 1904 put together! No other men had yet flown.

Although the United States Government, to whom the brothers had offered their invention complete in 1904 for $100,000, displayed little practical enthusiasm for the airplane, France and Germany were deeply interested, and in 1906 official representatives of both countries came to Dayton to make a first-hand investigation. They met the Wrights personally, they talked with witnesses to the flights, and, although they themselves did not see the machine, they went away convinced.

Because of the lack of interest manifested by the Board of Ordnance and Fortifications, the Wrights sought a market for their product abroad. With the help of Charles R. Flint and his agent in France, Hart O. Berg, the brothers tried to interest the British Government. The Wrights visited England, France, and Germany without immediate success in any of these countries. Wilbur Wright returned to America, but eventually arrangements were made with business men in France and Great Britain, and with the Italian government.

In the fall of 1907, stimulated by the success of the Wrights' foreign negotiations, the War Department sought an interview with the brothers, and on February 1, 1908, the Signal Corps asked for bids, basing their specifications upon the Wrights' own statements of what their plane could do.

The severity of the government's demands in the matter of a flying machine amazed even those familiar with the state of aeronautics. The American Magazine of Aeronautics, the only publication of its kind in America at this time, remarked that "The demands for a dynamic machine are of such a nature the likelihood of the absence of practical bidders is great."

The New York Globe commented

gloomily: "One might be inclined to assume from the announcement that the era of practical human flight had arrived . . . but a very brief examination of the conditions imposed and the reward offered for successful bidders suffices to prove this assumption a delusion.

"A machine such as described in the Signal Corps' specifications would record the solution of all the difficulties in the way of the heavier-than-air airship (sic!) and in fact finally give mankind almost as complete control of the air as it now has of the land and water. It would be worth to the world almost any number of millions of dollars, would certainly revolutionize warfare, and possibly the transportation of passengers; would open to easy access regions hitherto inaccessible except to the most daring pioneers, and would, in short, be probably the most epoch-making invention in the history of mankind."

The terms upon which the government invited bidders to submit proposals were in effect as follows: A heavier-than-air flying machine was to be produced, capable of carrying two men, of carrying gasoline enough for a flight of 125 miles, of attaining a speed of 40 miles an hour, of flying for an hour, and of landing undamaged.

In all, 22 bidders responded. The list is of very lively interest:

George W. Schultz.....$	30,000
Brown and Swingle.....	5,450
R. G. Dressler.....	5,000
O. M. Preston.....	20,000
A. F. P. Stenzy.....	10,000
W. R. Gorden.....	
.....$40, $50, and $65 per lb.	

Left to right, Lorin Wright, O. L. Welsh, Orville Wright, Lieut. Milling, and Wilbur Wright.

L. J. Brown.....	15,000
Jno. F. Cavanaugh.....	55,000
J. J. P. Boatman, per ton lifting capacity; 1-10 tons, at.....	7,000
A. M. Herring.....	20,000
Chas. M. Wanzer.....	1,000,000
A. M. Barker.....	850
A. E. Moline.....	1,389
J. M. Kairies.....	30,000
E. H. Young.....	5,000
Fred C. Schwartz.....	10,000,000
Wm. Harper, Jr.....	20,000
Frank and Hedden Co..	500
Chas. B. Nichols.....	52,568
A. W. H. Criepe.....	25,000
James F. Scott.....	1,000
Wright Brothers	25,000

It is entertaining to read the promises made by the bidders. One man said that his machine would sustain itself in the air without any machinery whatever and ascend from any ordinary place, either in calm or storm. Several bidders offered to exceed the speed of 40 miles per hour mentioned in the government specifications. The time of delivery varied widely, ranging from one month to five years. "It is a big undertaking," said one inventor.

The conditions of assembly in one hour proved troublesome to another bidder. He wrote: "This invention marks the most difficult and dangerous application of power and, while it will more than fulfil requirements, it cannot be disconnected or rebuilt in an hour."

One machine, offered at an extremely low price, was described by its creator as follows:

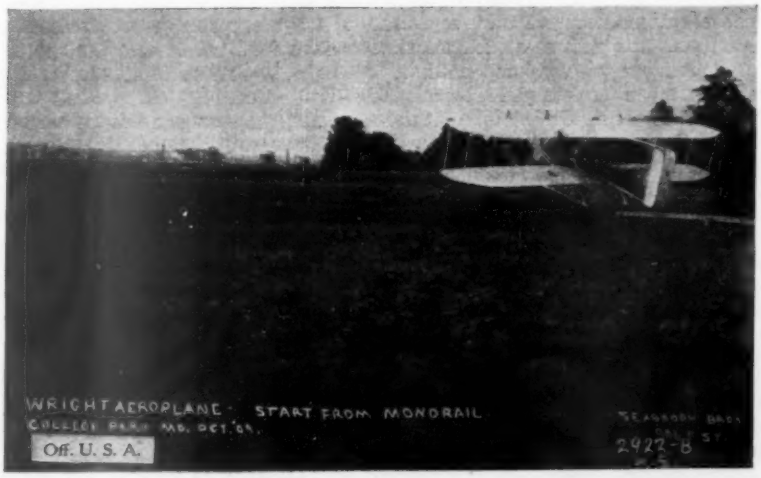
"Speed 100 m. per hour (arc planes silk, aluminum bands, steel wires and paper). Surface of airplanes two 7 x 11 ft., two 6 x 9 ft., one 9 x 16 drive plane, four sails 8 x 15 ft., three ground wheels, two guyre scope wheels, one blower, speed 1000 R.P.M., weight of machine, engine and everything complete ready for flight with two men, 700 lbs. . . ."

Somewhat more ambitious was the proposal of another man to furnish, for about the price of an up-to-date bombing plane, an

"airship carrying 15 men at a speed of 40 miles an hour, fuel for 3 days, with a 25 h.p. motor."

To prove that this was no idle dream the inventor wrote on his bid, "Bei Gott sind alle Dinge Moglich."

Only three of the twenty-two airplane builders finally submitted bids, the rest withdrawing from the field



Wright airplane taking off from monorail at College Park, Md., October, 1909.

when they discovered that the government required the posting of a forfeit. A. M. Herring of New York placed a bid for $20,000; James F. Scott of Chicago put in a bid for $1,000; the Wright Brothers announced a bid of $25,000.

On February 10, 1908, a contract was signed by Capt. Chas. S. Wallace on behalf of the Signal Corps, U. S. Army, and Orville Wright, on behalf of the Wright Brothers, for delivery to the United States of America "one (1) heavier-than-air flying machine in accordance with Signal Corps Specifications No. 486, dated December 23, 1907, for $25,000. Complete delivery to be made on or before Aug. 28, 1908."

Neither Herring nor Scott ever produced a machine. It is known that Herring never intended to build a plane, even if he had possessed sufficient knowledge to do so. His plan was to under-bid the Wrights, capture the contract, and then sublet it to the brothers, making his profit on business shrewdness rather than on more legitimate inventive capacity.

The second week in May, 1908, the Wrights resumed flight trials at Kitty Hawk in preparation for fulfilling their contract with the Signal Corps. The machine used in these flights was the same which the Wrights had flown in September and October, 1905, at Dayton, though it had been altered in certain particulars. A seat for a passenger had been added; the 1905 motor had been replaced by a later model, and a larger gas tank and radiator had been installed.

On the fourteenth, Wilbur Wright and Charles Furnas, the latter in the employ of the Wrights, flew together at a speed of about 41 m.p.h. This was the first passenger flight ever made. To this date the longest flight which had been accomplished by anybody else was an effort of 6 minutes and 30 seconds, by the French aviator, Leon Delagrange, on April 11, 1908. The last flight of the Wrights in 1905 had lasted 38 minutes.

After flying 13 times in 5 days, both alone and with a passenger, the Wrights packed up their machine, which had been damaged by Wilbur in a landing, and left for Dayton.

On the eighth of August, 1908, Wilbur Wright began flying at Le Mans, France, in preparation for a flying demonstration before representatives of the syndicate interested in securing the French rights. On September 5th he flew 19 minutes and 40 seconds, and on September 10th he was up for 21 minutes and 43 seconds.

On September 3rd Orville Wright started flying operations at Washington, and within a few days he had broken all records. On the morning of September 9th he flew for 57 minutes and 25 seconds, and in the afternoon he remained in the air for one hour, two minutes and fifteen seconds. The same day a third flight was made, with Lieutenant Lahm of the Army as passenger. This lasted six minutes and twenty-four seconds. On the tenth, eleventh, and twelfth the duration record was broken, the final mark standing at 1 hour, 15 minutes, at a height of 300 feet. The two-man record was also broken again on the twelfth, when Orville Wright flew with Maj. George O. Squier for 9 minutes and 6 seconds.

The death of Lieutenant Selfridge, following an accident on September 17, put an end to flight trials for the rest of the year. Lieut. Selfridge was flying as a passenger with Orville Wright when a propeller blade broke off at a height of about 150 feet. The plane glided part way to the field, but at an altitude of 75 feet it went out of control, ending the flight in a crash. Lieut. Selfridge was killed, and Orville Wright was severely injured.

We are greatly indebted to Mr. Ernest I. Jones, Chief of the Publications Section of the Aeronautics Branch of the Department of Commerce, for many of the hitherto unpublished items included in this article.

In the meantime, Wilbur Wright had been breaking all European records in his flights at Le Mans. On September 16 he made a flight alone of 39 minutes and 18 seconds. The best foreign record up to this time was the mark of 29:53.8 recently established by Leon Delagrange. On September 21, after an interruption of flying activities caused by the accident to his brother in America, Wilbur Wright made a new world's duration record, flying one hour, thirty-one minutes, and twenty-five seconds. This flight won the 5,000 f. prize offered by the Aero Club of France for the longest flight before September 30th.

Throughout September and October Wilbur Wright continued his flying, beating his own records and establishing new ones. On October 6 he flew with a passenger for one hour, four minutes, and twenty-six seconds, covering more than 79 kilometers, and thus fulfilling the condition imposed by the French syndicate. The syndicate had demanded a flight of 50 kilometers with a passenger.

On October 10 the duration record with a passenger was again broken, the mark now becoming 1:09:45.6.

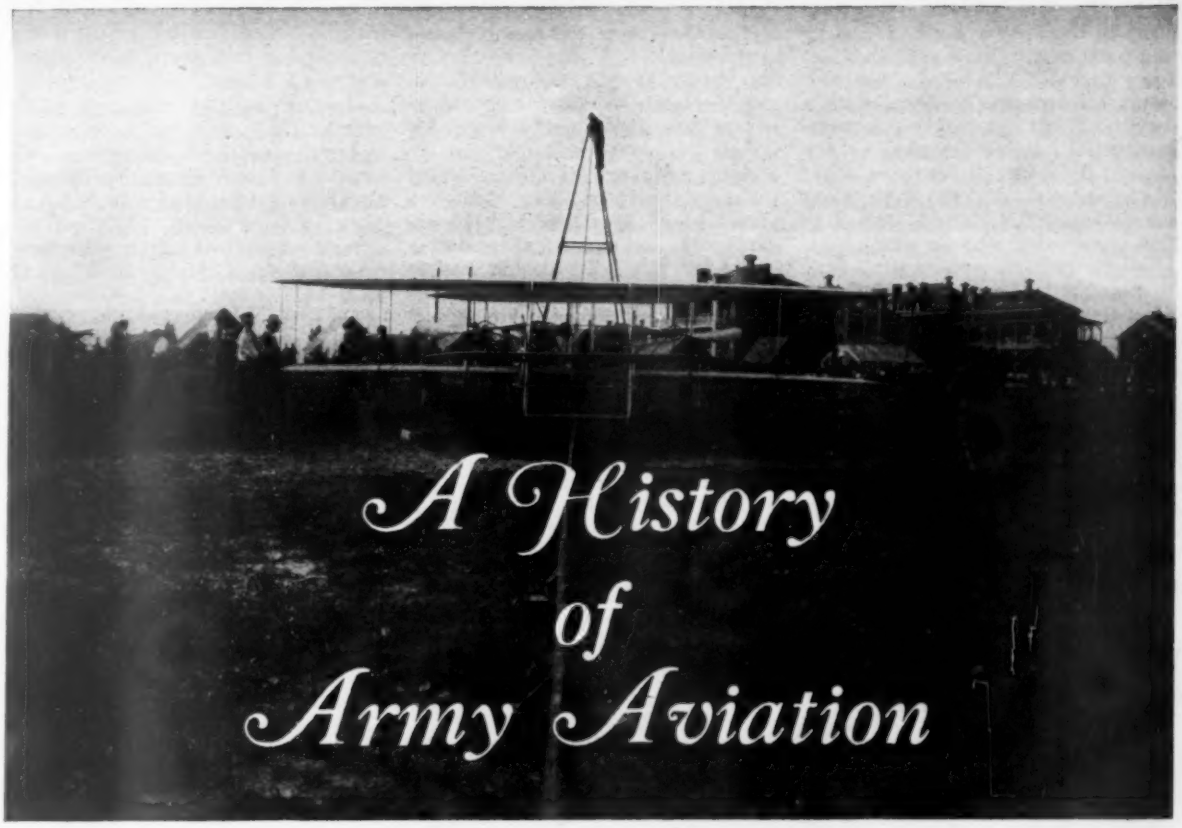
At the close of the month Wilbur Wright began the instruction of Comte de Lambert, Capt. Girardville, and Paul Tissandier at Pau. In the middle of November he won the height prize offered by the Aero Club de la Sarthe without using the catapult; in December he made a new solo record, and finally, on the last day of the year that had seen such brilliant achievements in aviation, Wilbur Wright established a new solo record for distance and duration, covering 124.7 kilometers in two hours, twenty minutes, thirty-two and two-tenths seconds, winning the Michelin trophy and other prizes.

In January, 1909, flying was begun again at Pau. Europe was tremendously excited. King Edward VII, King Alfonso, Prime Minister Balfour, Minister Barthou, Lord and Lady Northcliffe, and many other noted men and women visited Wilbur Wright at his flying center, and a number of these distinguished guests, among them King Alfonso, were given rides. Great crowds assembled to see the flying, and wherever Wright went he was feted and applauded.

Orville Wright joined his brother in Europe early in the spring, and on the first of April the brothers arrived in Rome to exhibit their machine to the Italian government under their contract. They were received by King Victor Emmanuel. On the fifteenth, Wilbur Wright made his first flight in Italy at Centocelli Field, Rome, in the presence of a most distinguished assembly. The instruction of Lieutenants Calderara and Savoia was begun the next day in the plane which the Italian government had purchased.

On May 11, 1909, the Wright brothers landed at New York, and in June they were received by President Taft at the White House and given the Aero Club of America medals. A week later, at a homecoming celebration in Dayton, the Congressional Medal was presented

(Continued on page 116)



A History of Army Aviation

Preparing for a flight at Fort Myer, Va.

By Falk Harmel
Information Division, U. S. Army Air Corps

ALTHOUGH the first flight in a heavier-than-air machine was made almost 25 years ago, December 17, 1903, to be exact, it was not until July 30, 1909, that the first military plane was delivered to the Army. Proposals for this plane were opened by the Signal Corps, U. S. Army on February 1, 1908. There were 22 bidders and the bids ranged from $500 to $10,000,000. The bid of the Wright Brothers was $25,000, and the War Department, evidently convinced that they were the only ones competent to fulfill the contract, finally awarded it to them.

In 1908, while his brother Wilbur was engaged in making exhibition flights in France, with the object in view of selling to the French government the patent rights to the plane, which was outflying every European competitor, Orville Wright arrived at Fort Myer, Va., and started demonstrating the Wright machine to interested Army officials. On September 9th, he moved his odd-looking mechanism out of its shed, and with only a little effort rose gracefully and easily into the air. In less than an hour he circled the parade ground 57 times at a height of about 100 feet. In the afternoon, he accomplished the first flight exceeding an hour's duration, completing 55 rounds in 62 minutes and 15 seconds. Later he took Lieut. Frank P. Lahm, the first American Army officer to fly in an airplane, as passenger for a flight of six minutes and 42 seconds.

Following these first public demonstrations of heavier-than-air flight, it may well be surmised that aviation was a most absorbing topic of conversation in Washington at that particular time. Crowds wended their way to Fort Myer to "see the thing fly." Washington's "finest" had no traffic problems to contend with in those days and, although the street car service to Fort Myer was nothing to boast of, the curious throngs managed to get there one way or another.

Continuing his exhibition flights, Orville Wright, on September 12th, established a new duration record for pilot and passenger, although the plane was in the air only 9 minutes and 6 seconds. His passenger on this flight was Major George O. Squier, Signal Corps, who was the Chief Signal Officer of the Army during the World War and is well known for his activities in the field of radio.

The first Army officer to meet his death in an airplane crash was Lieut. Thomas E. Selfridge, Field Artillery. Flying as passenger with Orville Wright on September 17th, the plane went out of control, due to the breaking of the propeller, and crashed. Mr. Wright was severely injured and Lieut. Selfridge died a few hours later. The Army thus lost one of the best posted men in the field of aeronautics at that time, a student and a man of practical ideas. Selfridge Field, Mt. Clemens, Mich., where the 1st Pursuit Group of the Air Corps is now stationed, was named in honor of the man who was the Army's first sacrifice to the science of aviation. This accident caused the suspension of further experiments for that year.

In July, 1909, the Wrights returned to Fort Myer with a new plane. It may be of interest to mention here that the specifications for the first military plane required that it should develop a speed of not less than 36 m.p.h., on its trial

flight; be able to remain continuously in the air for one hour; carry two persons and have sufficient fuel for a flight of 125 miles. The first Army airplane was powered with a 4-cylinder, water-cooled, internal combustion engine designed by the Wright Brothers. It developed about 25 horsepower at 1400 revolutions per minute. The engine, located in the center of the lower wing, energized two 8½-ft. wooden propellers, to which it was connected by means of chains. The propellers turned at about 400 r.p.m.

Towards the end of July, Orville Wright, with Lieut. Lahm as passenger, exceeded the duration requirement by remaining in the air for one hour, 12 minutes and 40 seconds. On July 30th, with Lieut. Benjamin D. Foulois as passenger, Mr. Wright, on a cross country trip totalling ten miles, five with the wind and five against it, exceeded the speed requirement by averaging a speed of 42 miles per hour, which entitled him to a bonus of $5,000 over the contract price of $25,000.

Trial flight over Fort Myer, Va.

After the formal acceptance of the airplane by the U. S. Government, Orville Wright left for Germany for business reasons, while his brother Wilbur remained in this country to teach the flying game to Lieuts. Lahm, Foulois and Humphreys. The first two named officers completed their course, but the latter was relieved from aviation duty before finishing his course and subsequently left the Army. Lieuts. Lahm and Foulois are now Brigadier-Generals in the Air Corps, the former being in command of the Air Corps Training Center at San Antonio, Texas, and the latter on duty in Washington as Assistant Chief of the Air Corps.

Army aviation as it existed during the latter part of 1909 boasted a personnel of 3 officers and 10 enlisted men, and equipment consisting of one airplane, an airship, a free balloon, a small captive balloon, and a 200-ft. balloon and airship shed at Fort Omaha, Nebraska.

One may inquire how the Army obtained its solitary airship. Captain Thomas Scott Baldwin was engaged in building dirigible balloons in California. Hearing of the success met with by Glenn H. Curtiss in building motorcycle engines and desirous of obtaining a suitable engine to propel his new airship, he proceeded to Hammondsport, N. Y., to consult with the man who is today one of the foremost producers of modern airplanes and engines. Curtiss started building engines for Baldwin, embodying improvements in them as he went along. It was not long before his product came to be known as the best motor in America for aeronautical work. The work of these two pioneers of the air attracted the attention of the government, and an order was placed for a big dirigible balloon for the use of the Signal Corps. Baldwin was commissioned to build the airship and Curtiss the motor to propel it. The Army dirigible was completed within the time specified, and in the summer of 1905 it was tested in Washington. Captain Baldwin acted as pilot and Mr. Curtiss as engineer. The airship met every specification and was accepted.

Captive military balloons were used by the U. S. Army at Santiago, Cuba, during the Spanish-American War. A few Signal Corps officers began free ballooning in 1906 and were quite active in 1907 and for several years thereafter. Students attending the Army Signal School at Fort Leavenworth, Kansas, were instructed in free ballooning at Fort Omaha, Nebraska.

Nothing worthy of note in the field of aeronautical endeavor in the Army was accomplished during the year 1910. In the following year three civilian aviation schools were established in this country. One was conducted by the Wright Brothers at Dayton, Ohio, and the other two were operated by the Curtiss Company, one at Hammondsport, N. Y., and the other at San Diego, Calif. Two Army officers were detailed to take flying training at Dayton with the Wright Brothers, Lieuts. Henry H. Arnold and Thomas DeW. Milling, and three at San Diego under the immediate direction of Mr. Curtiss, viz.: Captain Paul W. Beck, Lieuts. John C. Walker, Jr., and C. E. Kelly.

Lieuts. Arnold and Milling, now Majors in the Army Air Corps, received their training at the hands of the pioneer Wright flyer, Al. Welsh. The training ground was located at Simms' Station, where the Fairfield, Ohio, Air Depot is now located. An old barn served as the hangar to house several Wright machines. Windy weather was in those days very detrimental to flying. This made it rather hard for the students and the instructors, for it was necessary to be at the flying field before sunrise in order to take advantage of the lull in the wind at that particular period of the day, and also just before sunset, when similar conditions would prevail. How different things are today with high-powered planes and with trans-oceanic flying holding no terrors for our intrepid airmen!

At San Diego Mr. Curtiss conducted experiments with hydroplanes and flying boats, and considerable progress was made.

Congress, in 1911, having voted the sum of $125,000 for aeronautics, an airdrome was constructed and hangars erected at College Park, Md., some ten miles from Washington. An aviation school was organized there and Lieuts. Arnold and Milling were

assigned the duty of giving instructions to such officers as might be sent to this school. Two of the officers who received training at San Diego, Captain Beck and Lieut. Kelly, were ordered to San Antonio, Texas, with two machines, upon the completion of their course. Wright and Curtiss airplanes had been purchased by the Army, and the problem of determining which was more suitable for military work was investigated.

Active training at College Park began in July, 1911, and by the end of the summer six officers were holding pilots' certificates, and five planes were being operated. In addition to flying training, a limited amount of experimental work was conducted in aerial photography, radio from aircraft, and machine gun firing from the air at a ground target.

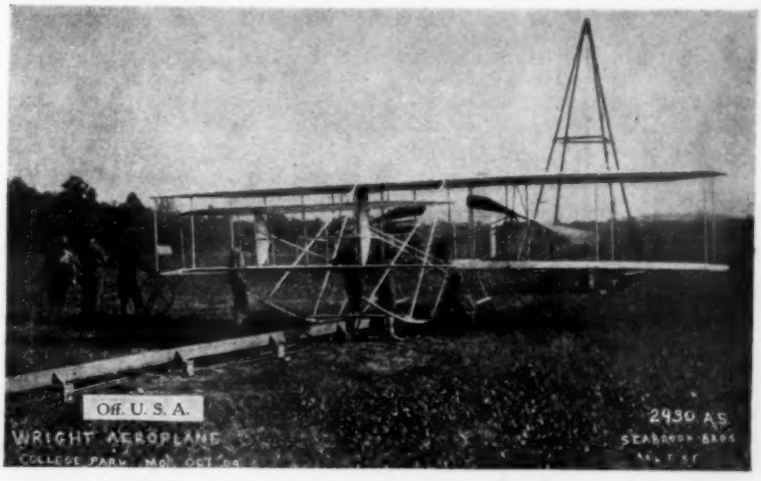
The training activities at College Park, which were suspended during the winter, were resumed the following spring, the school during the winter months being conducted at Augusta, Ga. In June, 1912, the first fatality occurred at College Park. Al Welsh, civilian flying instructor, was sent there with a new type of military plane for demonstration purposes. Welsh experienced difficulty in meeting the requirements of the War Department as to rate of climb, and finally came to the conclusion that the only way he could make the new machine attain the required climbing distance within the time specified would be to put it in a dive and then start it on its upward course, calculating that the dive would provide him with sufficient momentum to accomplish his purpose. It was a fatal error. The machine was unable to withstand the excessive strain put upon it and disintegrated in the air. Both Welsh and his passenger, Lieut. Leighton W. Hazlehurst, were instantly killed as the result of the crash. An accident at San Antonio, Texas, in the Spring of that year resulted in the death of Lieut. C. E. Kelly, in whose honor the present field there is named. Kelly Field is where the Army Advanced Flying School is located. It is the largest of all the present Air Corps flying fields.

With the death of Lieut. Kelly further flying activities at San Antonio were suspended, and the remaining pilot, Captain Beck, was sent to College Park, where training activities continued throughout the summer of 1912, further experiments being conducted with radio and photography. Frequent flights were made from College Park to Washington Barracks, some twelve miles distant, where an auxiliary landing field had been constructed.

The War Department established the rating of Military Aviator, and those who qualified therefor were awarded a gold medal. The Army flyers learned to operate the Curtiss and Wright machines as seaplanes, both being equipped with pontoons for this purpose. At that time the entire Air Service, concentrated at College Park, comprised 12 officers and 39 enlisted men, the equipment consisting of 12 Wright and Curtiss planes, not including the first Wright machine purchased which was used by Lieut. Foulois at San Antonio and later placed in the Smithsonian Institution.

Early in the fall new Wright and Curtiss planes of the pusher type (propeller in rear) were delivered to the Army and proved a distinct improvement over previous types. The Wright machine, designated as a 2-seater scout, equipped with a 6-cylinder, 50 h.p. engine, driving two geared-down propellers through a chain drive, had an endurance of 3 hours and a speed of about 45 miles an hour. The Curtiss single-seater type, powered with an 8-cylinder, 80 h.p. engine, had a radius of 100 miles and a speed of about 65 miles per hour. A Curtiss single-seater flying boat and a Wright-Burgess pontoon machine were included among these new planes. A temporary school for winter flying was established at San Diego, Calif., for the operation of the flying boats, while a small detail was sent to Palm Beach, Fla., to operate the Wright-Burgess plane. Late in the fall the College Park school was again moved to Augusta, Ga., for the winter period.

Strained relations between the United States and Mexico resulted in the transfer of the Aviation School from Augusta to Texas City, Texas, in February, 1913, to be followed by the Palm Beach detachment, the purpose being to provide aviation for the ground troops. The training of officers continued without interruption. At Texas City the flying equipment consisted of 7 planes, one of them, a Burgess tractor, being a modification of the Wright machine, with propeller in front, a modern type fuselage, and a 70 h.p. Renault engine. The marked superiority of this machine resulted in the pusher types being eliminated as rapidly as possible in favor of tractor types.



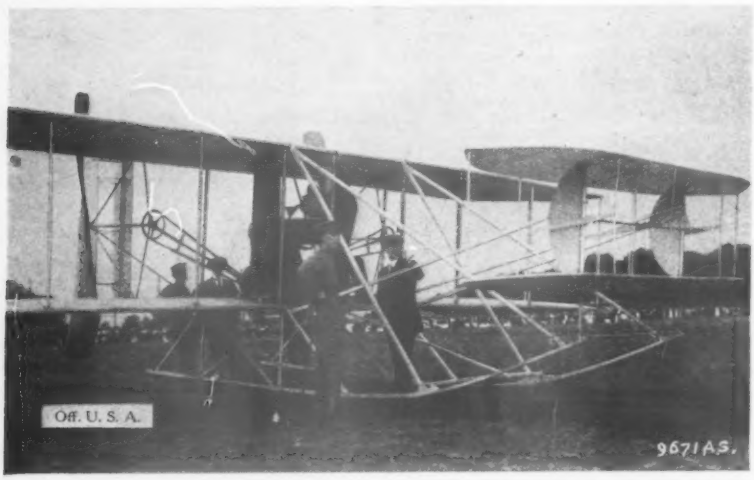
Early Wright biplane on the monorail.

The high death rate among the flying personnel and the difficulty experienced in obtaining suitable pilot material influenced Congress in 1913 to enact legislation providing for an increase in pay of 35 per cent to officers detailed on duty requiring them to participate regularly and frequently in airplane flights. A very noteworthy flight for that time was made by Lieut. Milling, on March 28th, when he negotiated the distance of 240 miles between Texas City and San Antonio in four hours and 22 minutes.

The College Park school was abandoned in favor of San Diego, California, and the operating personnel of the school at Texas City was moved to North Island, leaving behind a small detachment to continue aeronautical work with troops. By the end of the summer the school at San Diego had 12 officers under instruction, an enlisted personnel of 47, and seven of the total of fifteen planes which the Army possessed. The number of officers who had quali-

fied as Military Aviators up to that time numbered eleven, but only six remained with the Signal Corps, four going back to the line of the Army and one meeting death in an accident.

In March, 1913, an aviation school was organized in the Philippines, but it operated as such for only a short time and continued thereafter purely as an operating base. It was also decided to establish a school in Hawaii, and a small detachment was sent there for that purpose. This school also proved a failure and the detachment returned to San Diego. The plant at North Island, San Diego, consisted of temporary wooden hangars and shops, the enlisted men being quartered in tents and the officers being forced to seek quarters in the city. In the fall the total force at this school consisted of 23 officers in all stages of training. The enlisted personnel numbered 91, and the 17 airplanes on hand were of various types, only about half of them suitable for flying purposes.



Lieut. (now Brig.-General) Frank P. Lahm (left), and Orville Wright at Fort Myer. Note monorail on which the early Wright planes took off.

Army aviation received a more definite status in 1914 when Congress created the Aviation Section of the Signal Corps, specifically charging it, among other things, with the operation or supervision of operation of all military aircraft, etc. A personnel of 60 officers and 260 enlisted men was authorized, and the ratings of Junior Military Aviator and Military Aviator established. The first named rating carried with it an increase in pay of 50 per cent and the last named 75 per cent. An aviation student was entitled to a 25 per cent increase. Selection of aviation students was limited to unmarried officers of the line of the Army not above the age of thirty. Even this endeavor to make the aviation service attractive did not, however, serve to fill up the ranks of this new branch of the service to the extent authorized.

In the fiscal year ending June 30, 1914, officers who were engaged in flying made a creditable record, accumulating 749 hours of flying in a total of 3,340 flights. A limited amount of experimental work was conducted and knowledge was gained as to the characteristics necessary for a suitable type of military airplane.

September, 1924, saw the organization of a provisional squadron of the Signal Corps, with a strength of 16 officers and 77 enlisted men, equipped with 8 planes, but this squadron existed in name only. No equipment was on hand and it was necessary to make most of what was used. The personnel was engaged in various experimental projects in connection with lubricating oil, propellers, automatic stabilizers, signalling devices, smoke bombs, parachute packs, etc. Throughout the year the lack of funds handicapped development work, and in an attempt to relieve the situation Congress appropriated $300,000, the largest sum thus far authorized for the aeronautical branch. The National Advisory Committee for Aeronautics was created to supervise and direct the scientific study of the problems of flying. An account of this body developed in the years that followed and a resume of the notable work it has accomplished and is accomplishing at present would fill many pages with interesting reading matter.

The first instance of an American airplane being under enemy fire occurred in April, 1915, when, due to continued Mexican uprisings along the border, a plane was dispatched from San Diego to Brownsville, Texas, to cooperate with the Artillery there. The Mexican troops under the bandit Villa did not, however, make the expected attack, and so no opportunity was afforded the Army airmen to cooperate with the Artillery and adjust their firing. Nevertheless, the Army flyers carried out valuable reconnaissance work across the Rio Grand River, and while flying over Matamoras, Mexico, were subjected to rifle and machine gun fire. Shortly thereafter the plane was returned to San Diego.

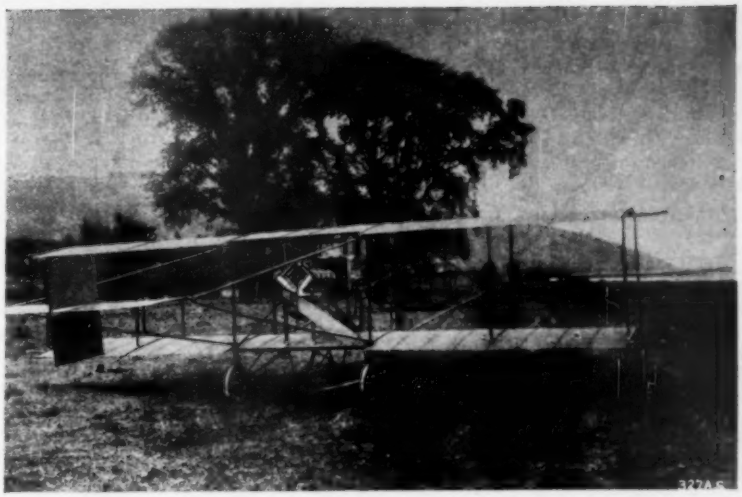
The 1st Aero Squadron, actually the first tactical aviation unit, was organized in the summer of 1915 and equipped with airplanes of the JN tractor type. Shortly following its organization it was ordered to Fort Sill, Oklahoma, where experiments were conducted in the observation of artillery firing in connection with the operation of the School of Fire for Field Artillery at that post. This work proved invaluable, but it was soon demonstrated that, while progress had been made and encouraging results obtained, the type of plane in use was inadequate and precluded the attainment of satisfactory results in the adjustment of artillery fire. While the unit was at Fort Sill experimental work in aerial photography was conducted, and the knowledge gained proved of material assistance in the redesigning of aerial cameras.

The mobility of an air unit was demonstrated in November, 1915, when the Squadron proceeded by air to San Antonio, Texas. Motor vehicles transported the enlisted men and ground equipment while the flight was completed in easy stages without incident. Almost 15 years later, that is to say, in the spring of 1928, a war strength bombardment squadron from Langley Field, Va., 23 attack planes from Galveston, Texas, and 23 pursuit planes from Selfridge Field, Mich., concentrated at Langley Field and from there proceeded to Fort Benning, Ga.; Fort Sill, Oklahoma; Fort Riley, Kansas; and Fort Leavenworth, Kansas; where the various Army Service Schools are located, for the purpose of staging air demonstrations. Some 85 enlisted men accompanied this provisional group, under the command of General Foulois, but all of them traveled by air, utilizing 15 transport planes. These planes collectively flew

a total distance of 330,000 miles without incident. This gives some inkling of the progress made in military aviation in that space of time.

With the passage by Congress in 1916 of a Deficiency Act appropriating half a million dollars for the Aviation Section, funds were available with which to purchase new equipment for the aero company in the Philippines, the enlargement of the school at San Diego and the establishment of a three months' course of instruction for field officers of the line of the Army to fit them for higher commands in the Air Service. By the end of the summer, 45 officers were undergoing instruction at San Diego, the greatest number which had ever been on duty there at one time.

On March 1, 1916, the First Aero Squadron, then composed of 11 officers, 82 enlisted men, one civilian mechanic and 8 JN airplanes, was moved from San Antonio to Columbus, New Mexico, for active duty with the punitive expedition under General Pershing across the Mexican border. The squadron was under the command of Captain Foulois. On March 19th it was ordered to proceed to Casa Grandes, Mexico, for immediate service. These 8 planes left the Columbus airdrome at 5:15 p. m. but none reached the destination that evening. One plane was completely wrecked, four landed at Las Ascension and the other three at separate points. Six planes arrived at Casa Grandes the following day and the seventh one several days later. Utilized for reconnaissance work, the brief participation of the squadron in the expedition demonstrated that the planes were unable to attain sufficient altitude to rise above the mountains for reconnaissance work. The squadron was consequently withdrawn from the expedition and returned to Columbus.



One of the first Army training planes at the San Diego school.

In May, 12 new Curtiss R-4 planes, equipped with 160 h.p. engines, were received by the squadron, and no time was lost in thoroughly testing this equipment and incorporating such changes as were found necessary. It was found that this new equipment gave a much superior performance.

On June 16th a flying school was established at Hazelhurst Field, New York, (named in honor of Lieut. Hazelhurst killed at College Park), and another one operated for a short time at Chicago. Several civilian schools were also utilized. By the end of June, 23 Regular Army officers had completed training and were on duty with the Aviation Section, Signal Corps, and 26 others were under instruction.

With the war raging in Europe, Congress, finally recognizing the great importance of aeronautics to the Army, appropriated in August the unprecedented sum of $13,281,666 for aeronautical development, practically ten times the total sum heretofore appropriated for any one year.

The declaration of war with Germany on April 6, 1917, found the United States with an air force, if such it could be called, of 65 officers (35 of whom were flyers), 1,087 enlisted men and 55 airplanes. Compared with the aircraft employed by the European countries at war, all of these planes were obsolete, being training types and hardly suitable for use against a well equipped enemy. None of our Army flyers had flying training of the type required by battle conditions, and only five had technical training as aeronautical engineers. No machine guns were mounted on the planes and only about half a dozen factories in this country had any experience in the production of airplanes. By this time seven squadrons had been authorized, but only one of them, the 1st Squadron, was fully organized. The civilian flying schools had trained a small number of pilots, and a few of these enrolled in the Reserve.

Shortly after the declaration of war, the First Aero Squadron was assigned to the First Division. It arrived in France on September 1st.

In the 8 years from 1909 to 1916, American aircraft manufacturers had delivered to the Army a total of 142 planes, hence the problem confronting this country in the matter of aircraft production may be appre-

Early seaplane at San Diego.

ciated when the French government presented a program to America calling for 16,500 modern airplanes in the first six months of 1918. This also meant about 10,000 additional planes with which to train the flying personnel to operate the service type planes.

America was amazed, for the task set before it was a staggering one. Nevertheless, it accepted the proposition and set to work with a will. The problem of mobilizing the country's man power was partly solved through the Selective Draft Act, but to train them for active service on the front was an entirely different matter, as we learned to our cost. It was ever thus, however, with our great republic, public opinion being steadfastly adverse to a large standing army. This was not the first time America was totally unprepared for war, for throughout our entire history this condition has confronted us. Although victory has perched on our banners in all our wars, it has invariably proved costly, not only on the score of lives sacrificed due to the necessity for utilizing inexperienced and untrained men but also because our resources have been overtaxed in our effort to make ready for war in great haste. The well-known adage that "haste makes waste" is well exemplified in our war experiences.

An infinitely greater problem which this country faced was to mobilize our industries for the great conflict. How this was accomplished is a long story by itself. Various boards were created, with men prominent in American industrial enterprises as members thereof. Responsibility for the production of aircraft was more or less taken away from the military authorities and placed in civilian hands. Money was available with which to proceed on a gigantic aviation program, Congress on July 24, 1917, having appropriated $640,000,000 for that purpose.

Army cargo plane. This is a Fokker C-2 transport, the type used by Maitland and Hagenberger in their flight to Honolulu.

Commissions were sent overseas to obtain data on the latest types of planes, and officers from the Allied armies came to this country to assist us in our training program. America's hopes ran high, for popular imagination visioned a vast air fleet playing a great part in winning the war.

Land was leased or purchased in various sections of this country and flying schools established thereon. Ground schools were opened at prominent universities, such as Princeton, Cornell, Illinois, Ohio State, Texas, California, Massachusetts Institute of Technology, etc. With the opening of these ground schools the youth of this country volunteered in large numbers for aviation duty, despite the general conviction that learning to fly was a most hazardous occupation. The physical requirements for aviation duty being much more exacting than for the other branches of the military service, only about 50 per cent of those who volunteered were found physically fit. The successful candidates were sent to the various ground schools where, in the space of seven to eight weeks, they were given as much instruction in the basic science underlying aviation as the limited time would permit.

While attending these ground schools the student had the status of "Cadets," and upon graduation were sent to the various flying schools for primary flying training. It usually required from three to four months for a cadet to receive his rating as a Reserve Military Aviator, immediately following which he was commissioned, usually as a 2nd Lieutenant.

Accidents were numerous, chiefly because the flying training system was not so well organized and the stress of the emergency did not permit the extreme care now exercised by the Army Air Corps in training flyers for the Army. One-fourth of the 22,542 cadets who entered the ground schools were eliminated as unfit, and of the 16,800 cadets who graduated 14,835 received flying training in the United States and 1,791 in France and England. Of the original number of applicants who applied for aviation training, slightly more than one-third succeeded in completing both the ground school and flying school courses. This number was further reduced by casualties in training. The training of the first classes was greatly retarded due to the shortage of flying instructors, but this situation gradually adjusted itself when competent flyers were obtained from the graduating classes and assigned to duty as instructors.

The problem of securing skilled mechanics for service with the various aero squadrons also proved a vexatious one. Thousands of men, skilled in mechanical trades, had been drafted into the National Army, and those not drafted took advantage of the alluring pay obtained in war industries. This situation was remedied in the course of time by transferring to the Air Service enlisted men of other branches of the Army who possessed mechanical experience. In addition to motor mechanic regiments, organizations were formed to work in the forests of our great Northwest with the purpose in view of cutting spruce for aircraft production, and companies of bricklayers were organized to build aviation schools in France. By March, 1918, the strength of the Air Service was approximately 11,000 officers

and 120,000 enlisted men, nearly as great as the whole United States Army prior to the war.

At the outbreak of the war only one concern in the United States, the Curtiss Company, was engaged in quantity production of airplanes, and it was producing about 100 planes a month for the British government. This plane was the JN4-D type, powered with the OX-5 engine. Not more than a dozen other aircraft concerns were in existence, and their production was on a limited scale. The vital need for planes to meet training demands finally resulted in seven of these factories taking over the production of training planes. Deliveries were slow at first, the Army receiving only six during the month of June, 1917. The production rate, raised to 78 in July, continued to increase, and with five additional companies which started to operate in November, a total of 2,837 JN4-D planes was delivered to the Army by the end of the year. This number was supplemented by 1600 J-1's, another type of training plane, powered with the Hall-Scott engine and produced by the Standard Aero Corporation.

These two types of planes, while they served the purpose for primary training, were wholly unsuited for advanced training in aerial machine gunnery, bomb dropping, formation flying, pursuit work, single-seater fighting, etc., because their speed did not exceed 80 miles an hour and they lacked suitable equipment.

New primary training ship of the P-T.-1 type. This plane is also being equipped with a radial motor.

The expectation that a series of foreign battle planes, chief among them being the British DeHaviland, would be manufactured in this country in time to begin advanced training early in 1918 did not materialize, and therefore the JN4-D was modified, equipped with a more powerful engine, the 150 h.p. Hispano-Suiza, and used as a temporary makeshift. By the end of May, 501 of these modified planes were supplied the Army, thus enabling some progress to be made in advanced training work.

For single-seater pursuit work the Army decided to use the Thomas Morse Scout. In September, 1917, 500 of these planes were ordered and by the end of the year 130 were delivered, which number proved sufficient to meet a large part of the demand at that time, since most of the single-seater training was received by our pilots in France.

Army dual motored bomber.

The DeHaviland two-seater, combination day-fighter and day-bomber, was the mainstay of the American aircraft program. Following the decision to adopt this British plane, four months elapsed before the model reached the Engineering Division at Dayton on August 26, 1917. Here it was remodeled to take the Liberty-12 engine, the design of which was one of America's outstanding achievements in aircraft production during the war. On September 5, 1917, a contract was given the Dayton-Wright Co. to build 2,000 D.H.'s, and the Fisher Body Corporation, one of the largest automobile body makers in the world, received a contract to manufacture 3,000 of them. Unexpected difficulties, however, delayed production, and by January 30, 1918, but four of these planes had been sent overseas. By the end of May, 155 D.H.'s had been delivered and 49 actually sent overseas. The first American-built DeHaviland equipped with the Liberty motor, took the air in France on May 17, 1918. This plane was bitterly assailed by American pilots in France, the principal criticism being that its radius of flight was only two hours, it was purely adapted for observation pur-

poses, and the lack of protection afforded the gasoline tank from machine gun incendiary bullets led to the coinage of the term "Flaming Coffin."

Inability to arrive at a definite decision with regard to the adoption of a suitable type of bombing plane and constant changes in the drawings and plans for a plane of this type greatly hampered production work on both the British "Handley-Page" and the Italian "Caproni." By the time the Armistice was signed sufficient parts had been manufactured to set up 70 Handley-Page airplanes in England. Two Caproni bombers—Italy's gift to the United States—were shipped to this country and assembled. These planes created a sensation, and it was decided to build 250 of them. The first airplane was completed in July, but subsequent misunderstandings with the Italian representative in this country delayed matters to such an extent that at the signing of the Armistice the initial airplane was still awaiting its final tests at Dayton, Ohio.

Army pursuit plane.

In 1918 construction work was started on several types of single-seater fighting planes, also on a number of airplanes designed around the Liberty engine, but when the war ended only a few of the fighting planes had been delivered.

To sum up America's aeronautical activities in the World War:

On November 11, 1918, 757 American pilots and 481 American observers, equipped with 740 airplanes and 77 balloons, were actually on the front, while 1,402 pilots, 769 airplanes and 252 balloon observers had been sent to the zone of advance. About 150 bombardment raids were conducted, in the course of which 275,000 pounds of explosives were dropped on enemy objectives. American aviators engaged in 2,100 reported combats, accomplished 12,830 pursuit, 6,672 observation and 1,174 individual bombing missions. More than 17,845 aerial photographs were taken of enemy positions and over 58,500 prints made.

Official reports credited American aviators with the destruction of 491 enemy planes, confirmed, of which number 462 were officially credited to 63 aviators. In addition to the 491 enemy planes, confirmed, 354 additional planes were reported as destroyed, but these were not confirmed. The number of enemy balloons reported destroyed was 87, of which 57 were confirmed.

There were 43 aero squadrons on the front when the war ended, of which number 20 were single-seater pursuit squadrons, 17 observation squadrons and 6 bombardment squadrons. Of the pursuit squadrons, 17 were equipped with the French "Spads" and 3 with the British "Sopwith-Camels." Eleven of the 17 observation squadrons were equipped with "Salmsons," 5 with American DeHavilands and one with the "Breguet A-2." Eleven more squadrons were equipped and ready to go to the front, and another 10 were being mobilized. Of the American units on the front, less than 25 per cent were equipped with American machines, although 1,379 DeHaviland planes had been received in Europe and 740 sent to the zone of advance. The American planes overseas comprised about 10 per cent of the entire Allied aircraft strength. America was just starting to get warmed up in the matter of furnishing pilots and American-manufactured planes and engines before hostilities ceased, and little opportunity was afforded to demonstrate to the world that Yankee energy was ultimately bound to make itself felt.

Military aviation continued under the supervision of the Signal Corps of the Army until the Spring of 1918. The progress made up to that time in building up an adequate air force and providing it with suitable equipment for service at the front apparently did not measure up to general expectations. Publicity given the aviation program had been entirely too extravagant. Criticism was abundant and bitter. Aviation officials were attacked and charged with negligence, misrepresentation and what not. President Wilson convened the Hughes Board to inquire into the situation. While the findings of this Board disclosed the fact that those in charge of the aviation program had performed their allotted tasks as well as could be expected under the extraordinary and unprecedented circumstances, President Wilson, nevertheless, on May 21st, effected a radical change in the organization of the Aviation Service. All aircraft activities were divorced from the Signal Corps, and two new aviation departments created—the Bureau of Military Aeronautics and the Bureau of Aircraft Production. Major-General Wm. L. Kenly, who at that time had just returned from France, was appointed as Director of Military Aeronautics, and Mr. John D. Ryan, the copper magnate, as Director of Aircraft Production.

With the advent of peace, these two bureaus were consolidated under the title "Air Service" and placed under the charge of Major-General Charles T. Menoher, who commanded the 42nd (Rainbow) division overseas. On October 4, 1921, General Menoher was succeeded by Major-General Mason M. Patrick, who rendered conspicious and efficient service during the War as Chief of Air Service, A.E.F. General Patrick remained at the helm until last December. when he reached the statu-

tory retirement age, and was succeeded by Major-General James E. Fechet, the present Chief of Air Corps. The Assistant Chief of Air Corps in Washington is Brig.-General Benjamin D. Foulois, the pioneer Army aviator.

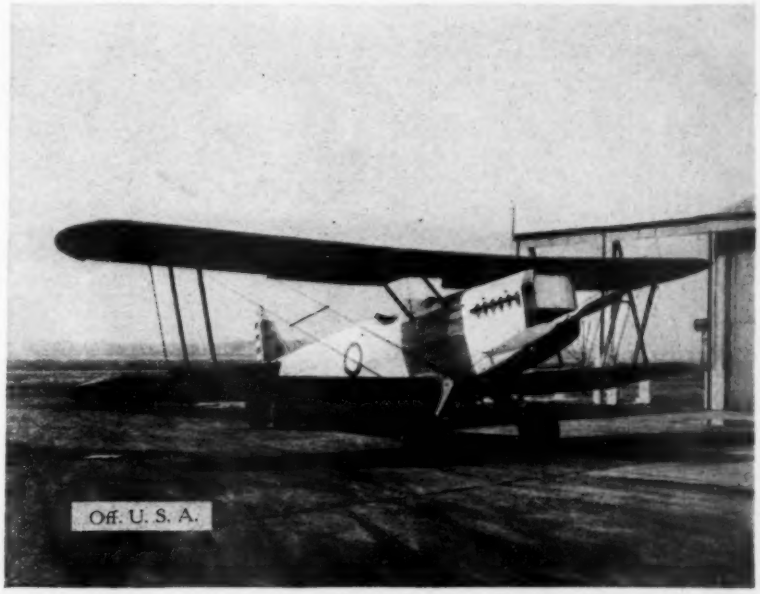
The signing of the Armistice necessarily caused a halt in aircraft production activities. Slow in starting, this industry was in full swing when the war ended, in consequence of which large quantities of equipment of all kinds were in storage at various flying fields and depots in the United States. It was by no means an easy task to terminate all contracts for aircraft material, determine what equipment would be needed for future, arrange for the disposition of supplies not needed, reduce the number of depots and flying fields, and consolidate the aeronautical activities of the army to keep in step with the future military policy of the nation.

Faced with the necessity of operating the Air Corps with the greatest economy possible, the Army rebuilt and reconditioned the large stock of war-built airplanes on hand at a fraction of the cost of new planes. For several years following the signing of the Armistice the flow of government contracts for aircraft material was so meager that many aircraft manufacturers were forced to go out of business. The slump in the aircraft industry was but natural, particularly with commercial aviation in the quiescent state that it was. Happily, with the recent revival of interest in aviation, many new aircraft concerns have sprung into existence, and for the first time since the war the outlook for the aircraft industry is promising.

With the Dove of Peace released from bondage and hovering overhead, demobilization of the largest army in American history was imediately started. The war strength of the Air Service, comprising over 18,000 officers and almost 135,000 enlisted men, dwindled down to approximately 1,000 officers and 10,000 men. The wholesale discharge of personnel, particularly enlisted men, placed upon the Air Corps the difficult task of securing men, sufficiently skilled in mechanics, to replace those who went back to civil life.

The Army Reorganization Act of 1920, which placed the Air Corps upon a definite military status, provided for a force of 1516 officers and about 10,300 enlisted men. As a matter of fact, however, in the eight years which followed, neither the commissioned nor the enlisted strength reached these respective figures. At no time did the officer personnel reach the 1,100 mark, and the present enlisted strength hovers below the 10,000 mark.

With the needs of the Air Corps being constantly brought to the attention of the public, through Congressional investigations, hearings, etc., Congress finally passed the Air Corps Act of 1926, authorizing a five-year expansion program, to be effected through five yearly increments, and contemplating at the end of that period 1,650 commissioned officers, 15,000 enlisted men, including 500 cadets, and 1,800 serviceable planes, not including those of an experimental nature. The name "Air Service" was changed to "Air Corps."



Army observation type. A Douglas 0-2.

While it would seem on the surface that the Air Corps had made very little progress in securing the necessary piloting personnel, this branch of the Military service has, nevertheless, accomplished considerable in the way of establishing a potential reserve of qualified pilots, now in civil life, who would prove a great asset to the country in a war emergency.

Following the cessation of hostilities, the Air Corps initiated a program of training young men from civil life as airplane pilots, and for several years conducted a primary flying school at Carlstrom Field, Arcadia, Fla., and advanced flying schools at Fort Sill, Okla., and Kelly Field, Texas. The school at Carlstrom Field was subsequently moved to Brooks Field, Texas, where it still flourishes. Last year another primary flying school was established at March Field, Riverside, Calif., where training activities were conducted during the war. All advanced flying training is now conducted at Kelly Field.

Flying students, who while undergoing training hold the status of cadets, upon successfuly completing the course at both the primary and advanced schools are rated as airplane pilots and awarded commissions as 2nd Lieutenants in the Air Corps Reserve. Quite a number of these graduates have passed the examination for appointment in the Regular Army and joined the ranks of the Air Corps. Thus far, however, the majority of the graduates have gone back to civil life, many to seek a career in the commercial aeronautical game.

The popularity of aviation among the youth of the country at this time is so great that the Air Corps can take care of but a fraction of those who make application for appointment as Flying Cadet, the accommodations at the flying schools being too limited at present. It is expected that this situation will be considerably improved, however, when the new Training Center at Randolph Field, near San Antonio, Texas, is completed.

Despite the many handicaps under which it labored, the Air Corps performed commendable work, both in

the matter of self-improvement as a virtually new combatant branch of the Army, and in demonstrating to the public at large the wonderful potentialities of the airplane as a peacetime utility. Cooperating with the United States Department of Agriculture, the Air Corps was instrumental in directing attention to the fact that, in addition to its use as a military weapon, and as an agency for the rapid transportation of passengers and goods, the airplane has many other uses. Army planes were utilized to patrol the great forests of the Northwest to detect forest fires; to spray poison powder over cotton plantations infested with the boll weevil, as well as alfalfa fields, orchards and other agricultural fields suffering from the ravages of various insect pests; to reforest stretches of territory, difficult to operate over by ordinary means, by casting tree seedlings from planes; etc. Experiments conducted in recent years of equipping planes with gelatine-covered glass slides and flying them through various air currents to catch wheat rust germs enabled agricultural officials to trace the source of these germs and to institute measures to eradicate their breeding places. It is safe to say that in a few years farmers will enjoy immunity from the ravages of a wheat-destroying parasite which caused them much grief in the past. In the Philippines the airplane was used to spray dust over agricultural fields suffering a veritable locust plague. The airplane did its work well.

In relief work in such instances as floods, tornadoes, outbreaks of contageous disease, etc., the airplane has proved a veritable "Angel of Mercy." Persons living in localities distant from adaquate hospital facilities were quickly transported via air to places where they could receive immediate treatment. The lives of many patients were saved through the speed and comfort which air transportation afforded. Medical supplies were time and again brought to stricken areas where delays incident to other means of transportation would have proved fatal. Ice jams in rivers were bombed to prevent floods and consequent possible loss of life and great property damage; flooded districts were patrolled, urgent messages, food and medicine being carried to aid in relief measures; searches were conducted for lost persons, etc.

A Curtiss Falcon, new Army attack type.

It is difficult to enumerate the many useful ways in which the airplane had already been utilized in peace time, and more difficult to visualize the many more possible uses it presents. Thousands of dollars were saved the Government in carrying out aerial photographing and mapping projects for such non-military government bureaus as the Coast and Geodetic Survey, the Geological Survey, the Bureau of Public Roads and the Forestry Service. It has been demonstrated beyond question that aerial surveying possesses a great advantage over the slow and tedious ground methods. The value of aerial photography was so well established that quite a number of commercial aircraft concerns are now engaged in this work. One concern in particular, has embarked in the profitable business of dusting cotton plantations by aerial methods.

The Air Corps devoted itself untiringly towards the establishment of landing fields and airways systems throughout the country. Adequate landing facilities are the very life of aviation, and this work was prosecuted with such vigor that at the present time all regular landing fields in this country have been mapped, as well as thousands of emergency landing fields. This work is now one of the functions of the Aeronautical Branch, U. S. Department of Commerce.

Planes taken over from the Air Corps by the Post Office Department paved the way for the present efficient system of air mail operation, lately taken over by commercial concerns. At various times Army pilots created outstanding records in airplane performance which served to arouse public interest. Numerous long-distance flights have been made, and the continent has been spanned so often, not only by individual pilots but by groups of pilots flying in formation, that a transcontinental flight nowadays is a commonplace occurrence.

The personnel of the Air Corps is distributed among 18 flying fields in the United States and among several flying fields in Hawaii, Panama and the Philippines. The largest concentration points of Air Corps troops in the United States are at the two Primary Flying Schools at March and Brooks Fields; at the Advanced Flying School at Kelly Field, Texas; at Langley Field, Va., the headquarters of the 2nd Bombardment Group; at Selfridge Field, Mich., the headquarters of the 1st Pursuit Group; at Fort Crockett, Texas, the headquarters of the 3rd Attack Group; at Rockwell Field, Coronado, Cal., where another Pursuit Group is in process of formation; at Scott Field, Ill., the lighter-than-air station of the Air Corps, where the Balloon and Airship School is located; at Mitchel Field, N. Y., a post of strategic importance and the base of the 9th Observation Group; and at Chanute Field, Rantoul, Ill., the headquarters of the Air Corps Technical School, where enlisted men are taught the various trades allied to aviation, such as

those of airplane and motor mechanics, welders, carpenters, radio mechanics and operators, aerial photographers, parachute riggers, etc.

All the pursuit aviation activities in the United States are concentrated at Selfridge and Rockwell Fields. The several types of Pursuit planes now in use are the most efficient that aeronautical engineers have thus far been able to devise. These small single-seaters are speedy, exceeding maneuverable, and possess a high rate of climb. The mission of Pursuit Aviation is mainly against enemy aircraft, though occasionally operations are conducted against ground forces. The Pursuiters' job is to clear the air of enemy aircraft, particularly hostile pursuit, and allow the observation and bombardment planes to do their work. Previous to the advent of the present PW-9 and P-1 types, the Air Corps was handicapped through the lack of satisfactory types of single-seater fighters. At this time, however, the Army pursuit planes are second to none in the world.

While bombardment aviation activities in this country are now confined to Langley Field, Va., it is planned to station another bombardment unit at March Field, Calif., when the new Air Corps Training Center (Randolph Field) is completed. Bombardment aviation is what its name implies—bombing, the main purpose being to drop bombs on predetermined objectives. The bombardment type of plane has not yet reached standardization, and the Air Corps is conducting experiments with single and multiple-engined types to determine which is more suitable to its purpose.

Attack Aviation, represented by the 3rd Attack Group at Fort Crockett, Texas, is a post war development, it having been discovered during the course of the great conflict that airplanes armed with machine guns and personnel bombs could be used with considerable effect upon troops and convoys. Because of the nature of its mission, the attack airplane flies at a low altitude to perform more effective "straffing" of troops, machine gun nests, convoys and other ground targets. The types of planes now used by the 3rd Attack Group are of recent design and construction, and therefore are modern and up-to-date.

The one Observation Group of the Air Corps has its headquarters at Mitchel Field, N. Y., where two squadrons are stationed. Individual observation squadrons are stationed at several other flying fields in the United States. The purpose of Observation Aviation is to secure information. Two-seater airplanes are almost invariably used, and it is generally necessary to carry camera and radio equipment. Observation pilots are only supposed to put up a defensive battle, their main business being to return to their home base with the information obtained.

Military airplanes are at the present time confined to the four main types above mentioned (Pursuit, Bombardment, Attack and Observation). It is now two years since the Curtiss JN training plane, fondly alluded to as the "Jenny," was wholly retired from service to make room for the new PT-1, now used by primary flying students at Brooks and March Fields. The war-time DeHaviland—"DH" for short—powered with the Liberty engine, is still in use to a limited extent. The stock of this now ancient observation plane is running low, and it is a question of only a short time until one will have to visit a museum to see it. The Air Corps, however, made good use of the DH. As the years went on several modifications were made in the plane, principally in improving its strength by the substitution of a metal fuselage. The "Old Reliable" Liberty-12 engine, which also underwent modifications and refinements—many of them—made possible a long list of wonderful achievements by Army pilots. The "Liberty" has had its day, however, and is gradually passing out of the picture to make room for the superior Curtiss D-12 engine.

The new observation planes now in use are the Douglas O-2, the Curtiss O-1 and the Loening Amphibian, the latter type being capable of landing on or taking off from either land or water. It is an ideal type for use in our insular possessions where considerable over-water flying is necessary.

A new advanced training plane, the AT-5, considerably more speedy and maneuverable than the primary type, is used at the Advanced Flying School. Several types of transport planes are also being used by the Air Corps to carry personnel and supplies, one being a Douglas C-1 and another the Fokker C-2, the latter the type which carried Lieuts. Maitland and Hegenberger successfully across half of the Pacific Ocean to Hawaii.

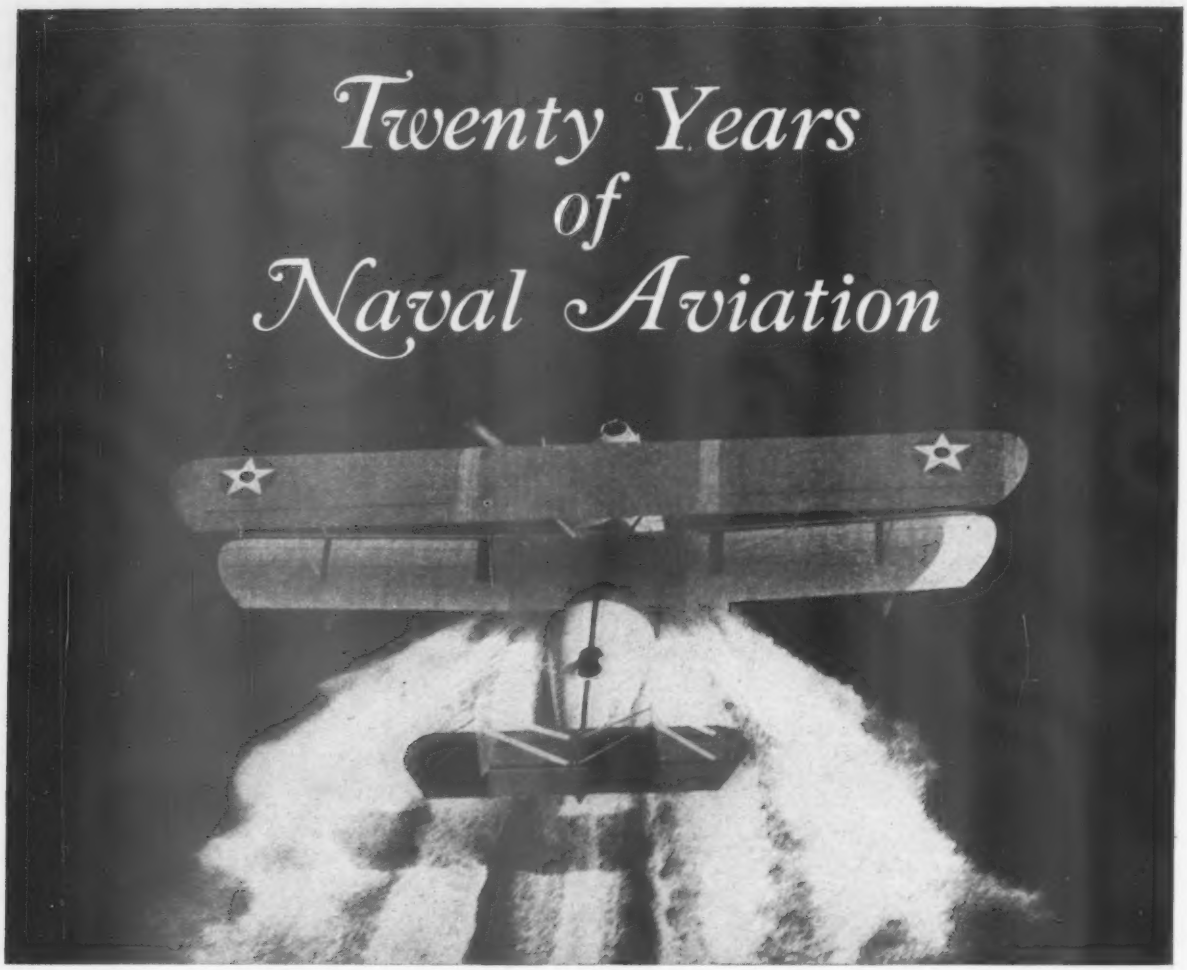
Loening amphibian of the type used by the army on the South American flight.

Prior to the introduction of the Keystone LB-5, the Air Corps bombardment pilots utilized the Martin twin-engined bomber and another of a similar type, called the NBS-1. While these planes are still in use, their days are numbered and they are slated to share the same fate as the "Jenny" and the "DH." It will thus be seen that the Air Corps has reached the stage where it is now using modern type airplanes which are faster, safer and more desirable in every way than the old war types—a situation which has to no small extent increased the morale of the flying personnel.

From the very beginning the Air

(*Continued on page* 114)

Twenty Years of Naval Aviation



Latest type of Navy patrol plane, a PN-11 flying boat, taking off.

By Rear Admiral William A. Moffett, U. S. N.
Chief of the Bureau of Aeronautics, Navy Department.

IN September, 1908, a little over twenty years ago, the United States Navy first took official cognizance of aviation. Orville Wright was demonstrating his plane to a number of government officials at Fort Myer, Va., and Lieutenant G. C. Sweet, U. S. N., and Naval Constructor McIntee, U. S. N., were detailed by the Navy Department to act as observers. It was on this occasion that Mr. Wright established a world's record for duration, remaining in the air for one hour, two minutes and fifteen seconds. The two naval observers were very enthusiastic over this performance and immediately suggested that an airplane be equipped with pontoons, which, if successful, would greatly improve its adaptability for naval use. However, their recommendation was not carried out. Two years later, Captain W. I. Chambers, U. S. N., then on duty in the Bureau of Equipment, Navy Department, acted in the capacity of official observer at the aviation meets held at Belmont Park, N. Y., and at Halethorpe, just outside of Baltimore, Md. Captain Chambers was very much impressed with the skill of the pilots and the durability and maneuverability of the planes demonstrated. Practically alone in his belief that the Navy needed aviation, Captain Chambers felt that this attitude of others would be changed somewhat if a convincing demonstration could be brought directly to the attention of the Navy in general. With this in mind he approached the Wright Company with the proposal that they fly one of their planes from the deck of a battleship. The Wrights declined to make such a flight so the matter was then taken up with the Curtiss Company who agreed to make the attempt. Arrangements were completed, Mr. Eugene Ely selected as pilot, and on November 14, 1910, the flight was made from a platform constructed on the bow of the U. S. S. Birmingham at Hampton Roads, Va. There were many Army and Navy officers and other government officials present and each left the scene with an entirely new idea—the possibility of Naval Aviation.

Mr. Curtiss, taking advantage of the profound impression which this flight had made, offered to teach a naval officer to fly, free of charge, as no funds were available for such instruction. His offer was gratefully accepted and in December, 1910, Lieutenant T. G. Ellyson, U. S. N., was ordered to report to the Curtiss Camp at San Diego, California.

The potential value of aviation to the Navy was brought out more forcibly the following month when

Mr. Ely landed on a platform built on the stern of the U. S. S. Pennsylvania anchored in San Francisco Harbor and a few minutes later took off from the platform and returned to his base.

In addition to learning to fly, a task difficult enough at that time, Lieutenant Ellyson was assisting Glenn Curtiss in experiments on a hydroplane attachment. Together they succeeded in perfecting such an attachment and Glenn Curtiss demonstrated the device by landing in the water alongside the Pennsylvania. His plane was hoisted aboard, hoisted out into the water again, the take off made from the water and the plane flown back to the base. Needless to say, this flight, in addition to the convincing demonstrations of Mr. Ely, greatly stimulated interest in Naval aviation, both in this country and abroad, and in reality, our active participation in aviation may be said to date from that time.

In the meantime, Captain Chambers had thoroughly investigated every phase of aviation and recommendations had been made to Congress. As a result, an appropriation of $25,000 for aviation was included in the 1911-1912 Naval Appropriation Act, and in March, 1911, Captain Chambers was detailed to the Bureau of Navigation and directed to devote his entire time toward the establishment of a naval aviation service. The majority of officers in the various Bureaus in the Navy Department were not convinced that aviation could be of any possible use to the Navy and many regarded it merely as a dangerous plaything. As the cooperation of these Bureaus was absolutely essential, the new assignment proved to be an exceedingly difficult one.

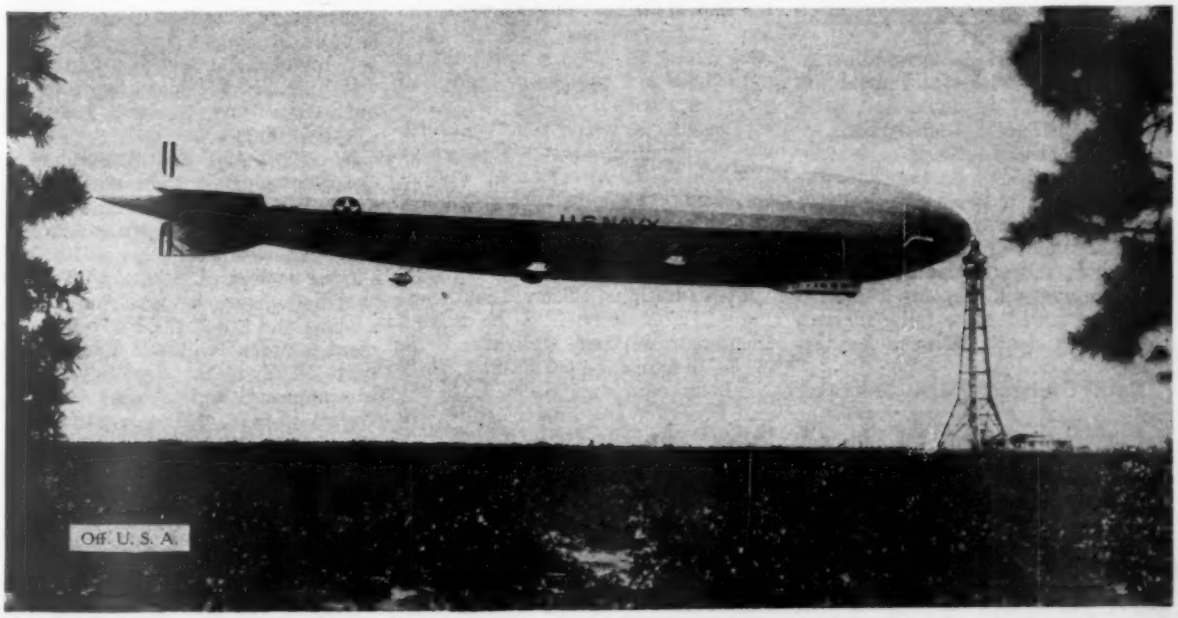
Rear Admiral W. A. Moffett, U. S. N.

In the spring of 1911, Lieutenant John Rogers, U. S. N., Lieutenant John Towers, U. S. N., and Ensign V. D. Herbster, U. S. N., were detailed to aviation duty and sent to the Curtiss and Wright camps for instruction. One Wright and two Curtiss planes were purchased, a camp set up at Greenburg Point, near Annapolis, Md., and the first Naval Aviation organization began operating. During the summer of that year, Lieutenant Ellyson made the first flight in a naval seaplane, being launched from a suspended cable.

From 1911 on, Naval aviators contributed much to the world's history of aviation. Progress was rapid and many notable flights were made, among which were Lieutenant John Rodgers' flight from Annapolis to Washington, D. C., from Washington to College Park, Md., and then to Baltimore and Havre de Grace and back to Annapolis; Lieutenants Ellyson and Towers' flight from Annapolis to Fortress Monroe, Va., and return, and Lieutenant Towers' establishing of a world's endurance record for seaplanes by remaining in the air six hours and ten minutes.

Naval constructor H. C. Richardson, U. S. N., Lieutenant (jg) G. Chevalier, U. S. N., Lieutenant (jg) P. N. L. Bellinger, U. S. N., Lieutenant (jg) W. D. Billingsley, U. S. N., First Lieutenant A. A. Cunningham, U. S. M. C., and First Lieutenant B. L. Smith, U. S. M. C., were detailed to aviation duty in 1912. These six officers brought the total to ten attached to this duty.

The first catapult was designed at the Naval Gun Factory in Washington, D. C., in 1912. The trial shot, with Lieutenant Ellyson as pilot, was unsuccessful and the complete project was turned over to Constructor Richardson with the order that he "make it work." He did. The catapult was redesigned and three months later was ready for test. Again Lieutenant Ellyson was se-



The U. S. S. Los Angeles.

lected as the pilot and on October 12, 1912, the first successful catapult launching was accomplished.

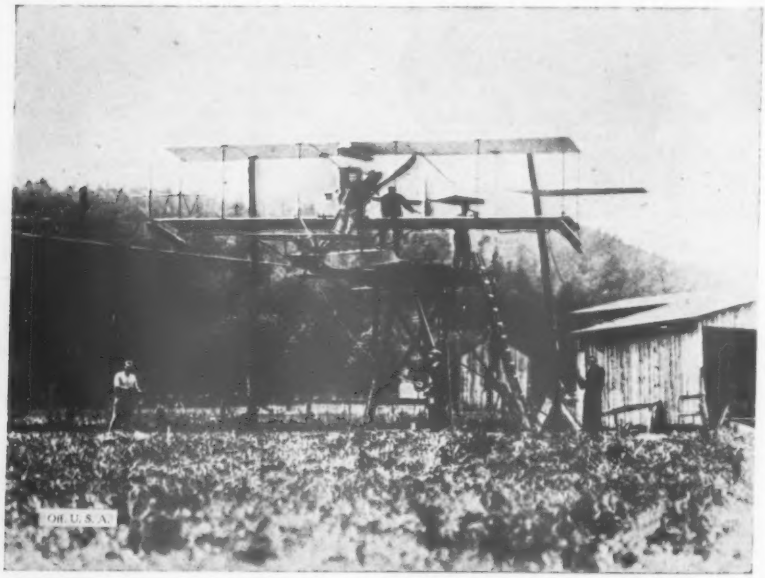
Another achievement worthy of note which occurred in 1912 was the construction of the aerodynamical laboratory or wind tunnel at the Navy Yard, Washington, D. C., under the supervision of Naval Constructor D. W. Taylor. This tunnel was built immediately after the purchase of the Navy's first plane and the aerodynamical data obtained through its use has been of great value.

In connection with the aeronautical laboratory, a model basin was constructed and the necessary instruments secured with which to obtain data pertaining to floats and hulls. Naval Constructor Richardson conducted a series of tests on model seaplane floats which gave the world the first scientific data on this subject. From these experiments were evolved floats and hulls of radically different lines from those in use at the time. The progress of seaplane construction was aided materially through the use of floats designed by this officer.

Naval Constructor J. C. Hunsaker made a study of European aviation during the summer of 1912 and upon his return to the United States was ordered to the Massachusetts Institute of Technology where he installed a wind tunnel and established a course in aeronautical engineering.

Another world's record for seaplanes was broken during this year when Lieutenant Bellinger flew a Curtiss seaplane to an altitude of 6,200 feet in 45 minutes. A little later, First Lieutenant B. L. Smith, U. S. M. C., made the first successful flight in an amphibian by taking off from the water, landing on a field and again alighting on the water.

When the Fleet went south in January, 1913, for the annual winter maneuvers, Naval Aviation accompanied it aboard a collier. This unit, under the command of Lieutenant Towers, was based ashore at Guantanamo. The entire time on the southern cruise was spent in experiments and tests pertaining to the coordination of aircraft with Fleet operations, and upon the return of the unit to its base at Annapolis, the fact that airplanes could perform such duties as scouting and locating mine fields and submarines had been practically demonstrated. The greatest benefit derived from the cruise was in bringing the possibilities of aviation to the attention of a number of officers who had not previously had an opportunity to see for themselves that it could do constructive work for the Navy.



Lt. Ellyson about to make a test flight from a wire launching device in a Curtiss pusher.

Five additional officers, Lieutenant (jg) J. D. Murray, U. S. N., Second Lieutenant William McIlvane, U. S. M. C., Lieutenant (jg) Saufley, U. S. N., Lieutenant (jg) Stoly, U. S. N., and Ensign W. D. Lamont, U. S. N., became Naval Aviators in 1913.

Aviation having made such progress, the Secretary of the Navy appointed a board in October, 1913, to make a careful study of the needs for an aeronautical organization within the Navy. Captain W. I. Chambers was appointed Chairman of the Board and a policy was outlined. One of their important recommendations was that an aviation training station be established at Pensacola, Florida. This was approved and the first U. S. Naval Air Station was built on the site of the abandoned Navy Yard at Pensacola, Florida, in January, 1914. All available aeronautical material, airplanes and pilots were ordered to Pensacola and Commander Mustin, U. S. N., placed in command.

A year later the aviation detachment operated again with the Fleet. Two planes with complete equipment were sent aboard the U. S. S. Mississippi which was ordered to Vera Cruz, and another attached to the U. S. S. Birmingham which was sent to Tampico, all three planes being used in connection with the occupation of Vera Cruz in April, 1914. The aviation detachment, especially that attached to the U. S. S. Mississippi, performed yeoman service and although not equipped for land operations made many scouting flights over the trenches in and around the city of Vera Cruz. Reports brought in by these scouting missions did a great deal toward the coordination of Army and Navy activities.

In the spring of 1912, Glenn Curtiss had a number of experimental projects on hand and as but few pilots were available it was arranged that Lieutenant Towers would, in addition to his other duties, do as much of this experimental flying as possible. During the next year and a half he did practically all of the flying of this nature that was done by the Curtiss Company. Many types of floats and pontoons were tested, discarded, or improved; the present day overhanging wing was tried out and found to be desirable and what was probably the most important—dual control was developed during this period.

While Curtiss and Towers were closely associated, they often talked of the possibility of building a plane capable of making a trans-Atlantic flight and in February, 1913, Mr. Curtiss wired Lieutenant Towers that he believed he could build such a plane and asked the Navy Department to order Towers to Hammondsport, N. Y. Mr. Curtiss' request was approved and together they designed and started construction of the twin engined flying boat "America." The outbreak of the World War at this time put a decisive end to that project but much very valuable data had been obtained which is the basis of present day "big-boat" development.

During the year 1914, Ensign C.

K. Bronson, U. S. N., Ensign W. A. Edwards, U. S. N., Lieutenant Kenneth Whiting, U. S. N., Lieutenant E. H. Maxfield, U. S. N., Ensigns E. O. McDonnell, Wadleigh Capehart, E. W. Spencer, H. T. Bartlett and George D. Murray were ordered to aviation duty. Since that time, regular classes, each larger than the preceding one, have been trained.

The first Navy designed seaplane was constructed at the Washington Navy Yard in 1915. Naval Constructor Richardson designed the plane, supervised the construction and tested it personally. The general appearance was similar to our present bombing type. It was equipped with two engines, one turning to the right and one to the left to offset torque; balanced control surfaces were used and three floats installed instead of the conventional one or two used in modern construction.

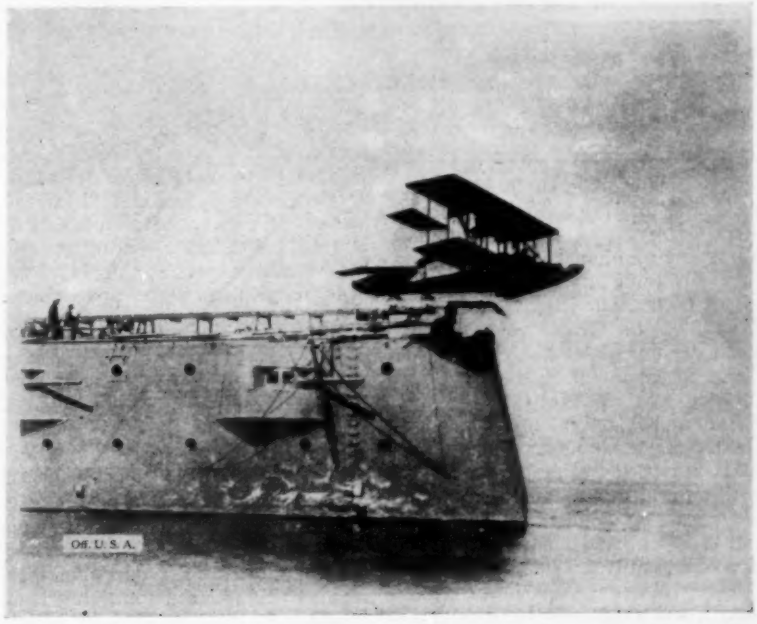
While the entire Navy was faced with the problem of expansion in 1917 at the declaration of war, the situation in the flying branch was particularly acute as aviation was comparatively new and quantity production of airplanes was practically unknown. Due to limited facilities and the fact that the Navy required fewer planes, the aircraft manufacturers were more interested in filling Army contracts than they were in building airplanes for the Navy. In order to insure our requirements being met at least partially, it was decided that a Naval Aircraft Factory should be built as soon as possible. This plant would serve two purposes, one, to produce airplanes, and the other, to provide facilities for the experiments necessary to every phase of aeronautics, especially in this case where time was most important.

The first ground was broken four days after the contract was let on August 6, 1917, machinery was installed in October, and the factory stood entirely completed on November 28th, one hundred and ten days later. The building was four hundred feet square and was completed in every detail necessary to the manufacture of aircraft. Shortly after the completion of the main factory the aviation program was quadrupled, additional space and machinery were required, and several additions, covering four or five times the space of the original plant, were completed a few months later. Sufficient skilled workmen and trained aviation engineers were not to be had, and hence production was comparatively slow at first while the personnel was undergoing training. Considering this, the output of the factory was extremely creditable. One hundred and eighty-three twin engine flying boats had been delivered at the time the armistice was signed.

On the date war was declared we had only one Naval Air Station, located at Pensacola, Florida, and a total of 38 naval aviators and 163 enlisted men. On November 11, 1918, twenty-one schools and stations were in operation in the United States and two thousand eight hundred and thirty-five officers and thirty thousand six hundred ninety-three enlisted men were attached to the aviation establishment. Of this number, one thousand, two hundred and thirty-seven officers, and sixteen thousand, two hundred eighty-seven enlisted men were sent overseas.

A total of twenty-two aviation bases were established abroad and several others were under construction at the end of the war. Twelve of these were in operation in France. The first American patrol of the French Coastal Unit was made at Le Croisic on November 13, 1917, and the last at Brest, on December 3, 1918, when the Presidential Convoy was met and escorted into port by American planes and dirigibles. The French Coastal Unit operating for an effective period of nine months, sighted twenty-seven submarines, attacked twenty-five, damaged twelve and probably sank four. In addition, Navy planes from the French Stations discovered and destroyed a large number of drifting mines. Escorts to convoys were provided and scout patrols were maintained as a matter of regular routine, and in addition to this a section of planes was kept in readiness to proceed to any point in the vicinity where submarines had been reported.

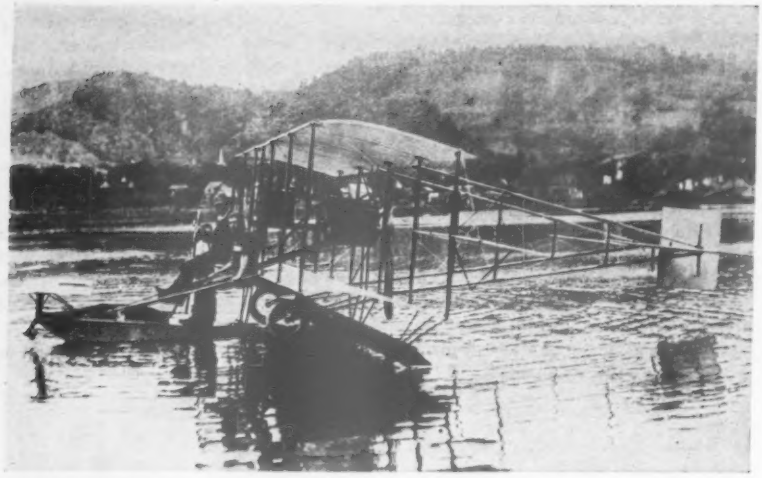
Seven stations were established in the British Isles and during the war our patrol planes there flew more than forty thousand miles. Seven submarines were sighted and bombed, two of which were known to have been badly damaged, but the results of the bombing of the other five are not known.



Flying boat being catapulted from U. S. S. North Carolina, November, 1915.

Three Air Stations in Italy were taken over by the Navy, one of which was a training station. Extended operations were conducted from the second, while the third was not completed when the armistice was signed. In addition to submarine patrols over the Adriatic, many bombing missions were carried out against the Austrian Naval Base at Pola.

Eight landplane squadrons were sent to northern France and operated with the British against the submarine bases in Belgium. Later, when these bases were abandoned, bombing raids were directed against objectives behind the German lines at Steinbrugge, Bruge, Ghent, Thielt, etc. The eight squadrons were designated the Northern Bombing Group, comprising four squadrons of night bombers operated by Navy personnel and four squadrons of day bombers operated by Marines.



Curtiss pusher amphibian.

The Marines took the first step toward the inception of aviation in their Corps by ordering Lieutenant A. A. Cunningham, U. S. M. C., to duty involving flying on May 21, 1912. Lieutenants B. L. Smith, L. T. Evans, R. S. Geiger and William McIlvane were later assigned and at the outbreak of war Marine Corps aviation was made up of these five officers and thirty enlisted men. The same war time expansion found necessary in the other branches, applied as well to Marine Aviation and as a result it consisted of 282 officers and 2,180 enlisted men at the cessation of hostilities.

The "Marine Aeronautic Company" was organized in May, 1917, and began training at the Philadelphia Navy Yard. Some months later the unit was divided into two groups; the first, which retained the original designation, was ordered to Cape May, N. J., and in December, 1917, to Ponta Delgada, Azores, where submarine patrols were flown until the end of the war. The second was designated as the "First Aviation Squadron," and ordered to Mineola, Long Island, where it trained with the Army until January, 1918, when it was ordered to Gerstner, also an Army Field, at Lake Charles, Louisiana. In March, 1918, it was transferred to Miami, Florida, where four squadrons began intensive training for assignment with the Northern Bombing group in France.

An interesting point in connection with these Marine aviators was that although they were qualified pilots and had soloed while stationed at Mineola, and had passed the "Reserve Military Aviator's Test," they could not be considered Military Aviators because they had no connection with the Army, and the Navy refused them Naval Aviators designations as they had not flown seaplanes. However, after arriving in Miami, the First Squadron passed the necessary tests at the Naval Air Station at that place and became Naval Aviators some months after qualifying on landplanes.

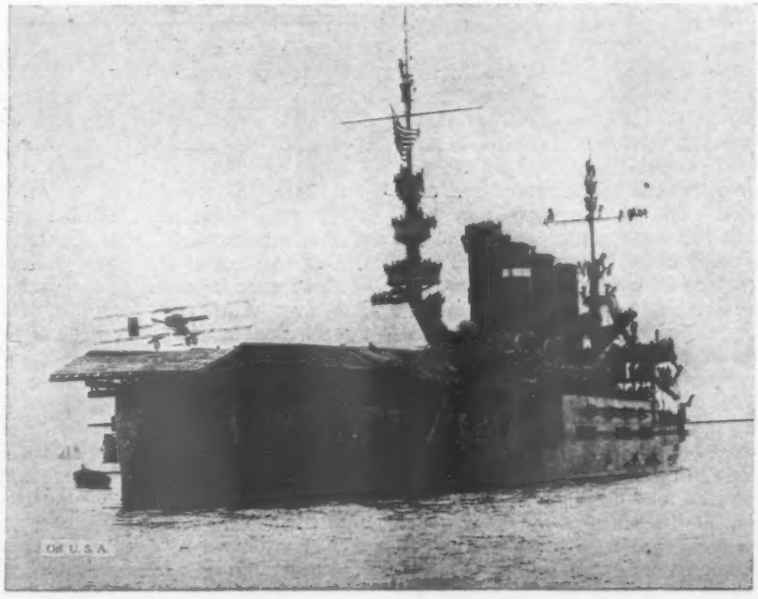
In August, 1918, the four squadrons arrived in France and until 11 November, suffered four casualties, shot down eight enemy planes and dropped 5,200 pounds of bombs on 57 raids over the lines.

The memorable flight of the NC boats in 1919 was the culmination of plans laid during the war when there was an urgent need for flying boats overseas for patrol and scouting missions, and all available space on transports and commercial ships was being used to carry necessities to our troops. It was practically impossible to ship the flying boats then under construction as they were very large, hard to handle, and required a great deal of space on board a ship.

As a solution to the problem, it was suggested that they be flown to England via the Azores and Spain. This plan was adopted but the Armistice removed the necessity for carrying it out. The Navy was confident that the new NC's were capable of accomplishing such a flight so preparations went forward with one division of these planes, and on May 16, 1919, the NC1, NC3 and NC4 took off from Trepassey, Newfoundland, under the command of Commander John H. Towers, U. S. N. Encountering a heavy fog, the NC1 and NC3 landed near the Azores to determine their positions but the heavy seas prevented their taking off again. However, the NC4, with Lieutenant Commander A. C. Read, U. S. N., in command, reached Horta on May 17th, took off on the 20th, and arrived in Ponta Delgada two hours later. She left the Azores on May 27th and arrived in Lisbon, Spain, the same day. The final leg of the flight was completed four days later when the NC4 arrived at Plymouth, England, on May 31st, the first airplane to fly across the Atlantic ocean.

The Navy purchased its first air-

Ely making first landing on the deck of a battleship, Jan. 18, 1911. The ship was the U. S. S. Pennsylvania, and the platform was 32x127 feet.



ship, a non rigid, in 1915. It was completed and delivered two years later but when tested was found to be too heavy and was soon dismantled. A design for a "B" type patrol airship which had a twelve hours' cruising radius was then approved by the Secretary of the Navy. The original plan called for the purchase of one of these ships, but sixteen were ordered as they would be needed if war was declared and the contracts could be altered if foreign relations became less acute. All sixteen were delivered during the latter part of 1917 and the first six months of 1918. They were used for the training of airship personnel and coastal patrol, flying approximately 400,000 miles on this duty. An airship of more advanced type was designed early in 1918 and a contract let for thirty. These "C" ships, of which ten were delivered before November 11, 1918, were larger, faster and in all very satisfactory, exceeding in many respects the performance expected of them. One of this group established a record by flying 1,022 nautical miles in twenty-five hours and fifty minutes.

In close succession followed the "D," "E," and "F" types, each being a modification of previous types though not differing radically from them. A "G" type, to be much larger than any previous non-rigids, was designed but never built as rigid construction was then adopted for large airships. The last of the Navy's non-rigids were designated the "J" ships, two of which are now being used for training purposes.

Naval Aeronautics Station at Pensacola, Fla., March, 1914.

With the plans of the German L-49, and other information as a guide, the U. S. S. Shenandoah was designed by the lighter than air technical staff of the Navy, under the supervision of Commander J. C. Hunsaker, U. S. N. The ship was constructed at the Naval Aircraft Factory, Philadelphia, assembled at the Naval Air Station, Lakehurst, New Jersey, and went into commission in October, 1923. Before she was destroyed by a severe storm over Ohio in September, 1925, she made many notable flights, including one to the west coast and return.

In connection with the reparations program at the end of war, it was agreed that Germany should build a large rigid airship for the United States. So at the Zeppelin plant in Freidrichshafen, the LZ-126 was constructed, with Commander Garland Fulton (CC), U. S. N., inspector in charge. The first tests were made in September, 1924, and the following month, the LZ-126, manned by a German crew, was flown from Friedrichshafen to Lakehurst, a distance of 5,000 miles in 80 hours. Shortly after arriving there her original designation, which signified that she was the 126th ship to be built by the Zeppelin Company, was changed, and she was christened "U. S. S. Los Angeles" and assigned to the Navy. The Los Angeles has been in service for four years and in that time has made numerous flights, several of them particularly worthy of note: she has flown to Bermuda, Panama, and San Antonio; landed on the deck of the aircraft carrier Saratoga demonstrating the feasibility of refueling at sea; she has calibrated all radio compass stations on the Atlantic coast, and has been the subject of countless experiments, all tending to increase activities in the lighter than air field, one of the most important results being the development of new and more efficient handling facilities.

The two new large dirigibles recently contracted for are a direct result of the country's interest in lighter-than-air aeronautics kept alive by the operation of the Navy's rigids, Shenandoah and Los Angeles. The contract for the two new ships was let to the Goodyear-Zeppelin Company, Akron, Ohio. Each will have a volume of 6,500,000 cubic feet capacity; will be 785 feet

Navy single-seater fighting plane.

long, 132.9 feet in diameter, 146.5 feet high, have a total of 4,480 horsepower, and a maximum speed of 72.8 knots. Provision has been made to carry a small number of fighting planes aboard each airship.

Immediately following the world war, Naval Aviation was faced with some of the most serious difficulties of its rather short career. Many pilots and skilled mechanics were leaving the service and Air Stations were being dismantled or left with merely skeleton crews to carry out routine operations. It was generally felt that additional types of aircraft were needed to supplement the striking forces of the fleet and that patrol

Navy torpedo plane.

planes, our only well developed type at that time, were not sufficient. No means had been evolved to take planes to sea. Consequently, it was decided to experiment with the collier Jupiter, the first electrically driven ship in the United States Navy, and convert her into an airship carrier. The Jupiter was rechristened the U. S. S. Langley in 1922, when she went into commission. An arresting device, similar to that aboard the Langley, had been set up at Hampton Roads, Va., and the carrier pilots trained in this way for deck landings. Although the Langley was and is an experimental project, the data obtained proved valuable toward the conversion of our two new carriers the U. S. S. Saratoga and U. S. S. Lexington. These ships were originally laid down as cruisers but during their construction were converted into carriers in connection with the Washington Treaty for the Limitation of Armament. They went into commission during the latter part of 1927 and joined the fleet early in 1928. The U. S. S. Lexington and Saratoga are 888 feet long, 106 feet wide, each has a speed of 33.5 knots and is driven by motors of 180,000 horsepower. Both ships can operate approximately 75 airplanes and each is a self contained, completely equipped floating aviation base.

The first turntable catapult was constructed and installed on the U. S. S. Maryland in 1921. Three additional catapults of this type were ordered after the U. S. S. Maryland tests and before these were completed an order for twenty more was placed. As a result, each battleship and cruiser in the United States Navy today carries its complement of aircraft, with planes always ready to be launched from modern, efficient catapults.

President Coolidge appointed a Board in September, 1925, for the purpose of deciding the best application of aircraft in National Defense. As a result of this Board the Five Year Building program for Naval Aviation was evolved. The Bill created the new position of Assistant Secretary of the Navy for Aeronautics, authorized the construction of two large rigids and one small, all metal airship. One thousand modern planes were to be on hand at the end of the five year period with sufficient personnel to operate them. This legislation has had a most important bearing on the future of Naval Aviation as it has provided a definite goal to be attained.

One of the most important post war achievements is the development of the air-cooled engine. This power plant, lighter than the water cooled type, gives much better performance and eliminates the possibility of forced landings due to broken water connections, radiator leaks and defective water pumps. Commander E. E. Wilson and Lieutenant Commander B. E. Leighton, working in conjunction with the manufacturers, were largely responsible for the design of these engines. Aircooled power plants, ranging from 200 to 550 h.p. are now standard equipment in the Navy and are installed in every service type of plane in operation. Another noteworthy advance is the substitution of metal alloys for wood construction. Metal is lighter, stronger, does not deteriorate so quickly, and affords far greater protection to the pilot and passengers in the plane, in case of a crash.

Self starters, principally of the inertia type, are now installed in all engines, thus saving time, labor, and affording added safety to operating personnel.

Other developments covering every angle of aircraft construction have been incorporated in our planes. A glance at the list of airplane world records will readily convince the most skeptical that our aircraft compare favorably with those of any country and that the time and money expended on them has not been in vain. Of 69 records, exclusive of those for light planes, 24 are held by the United States and of this number 19 were established by the Navy. Of thirty-six seaplane records established, eighteen are held by Naval aviators. It should be noted that these records were made with service types of planes and that every type of flying is included, as the records range from altitude and speed for various distances with no load, to endurance flights with loads up to 4,400 pounds.

At the present time there are five types of planes in use in the Navy, namely; fighting, observation, torpedo, patrol and training. Each has its specific duty to perform and is designed especially for that duty. In this connection I might add that features of design for Navy planes differ radically from those applied to military and commercial aircraft. Large patrol flying boats are often called upon to land and take off in heavy seas, hence they must be of very rigid construction. Fighting, observation, and torpedo planes are carried on board ship and are subject to the additional strains of being catapulted and landing into arresting gear. Consequently, they must be of sufficiently rigid construction to withstand being operated in this manner.

It may be said literally that aviation goes to sea with the Fleet. Airplanes are carried on 37 ships, including battleships, cruisers, aircraft carriers and tenders. Aviation par-

(*Continued on page* 113)

The Future of the Air-Mail Service

By Hon. W. Irving Glover
Assistant Postmaster General

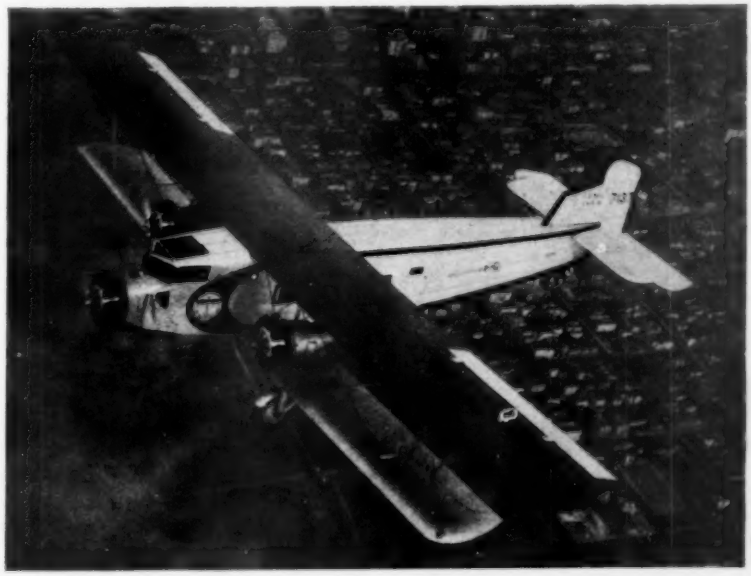
THE future of the Air-Mail Service is very promising. The outlook for its expansion is bright. The Air-Mail Map of the United States is undergoing continual and almost daily changes—representing accessions to the existing network of aerial-mail transportation lines. Already, approximately 65,000,000 persons of this country or more than one-half of the entire population are direct beneficiaries of this advanced method of postal transportation. I predict that within two years every city with a population of 50,000 will have direct access to one of these air-mail routes.

The Air-Mail Service of the future will transport large volumes of mail at night. Distribution of these letters and packages will be effected in the air—thus introducing the Air Post Clerk. This newly titled postal worker will occupy a position corresponding to that of Post Office, Sea Post and Railway Mail Clerks. The only difference between his job and that of his conventional fellow worker is his mode of travel—distributing mail while speeding on wings, if you please! The quarters and facilities of the Air Post Clerk will not vary widely from those of the older mail-distributing services.

Aircraft manufacturing companies have already submitted to the Post Office Department blueprints necessary to the distribution of mail during an airplane's course of flight. This and other demands indicate that the future Air-Mail Service will require flying machines of enlarged carrying capacity. These larger airplanes will transport from one to two tons of postal matter, the Air Post Clerk, and passengers. Inevitably, this increased air transportation is bound to deprive the Railway Mail Service of some of its present postal tonnage, thus releasing much space in the postal cars of our railroad transportation systems.

Obviously, this loss of revenue to the railroads will be met, in part at least, by the railway companies recognizing this new mode of transportation—taking the airplane into partnership with the railroad, as it were. This coalition is already apparent between some of the railway systems and air transport companies. The railroads—unlike the trolley companies which in many instances have failed to recognize the encroachments of the bus system of transportation—will invade the field of air transportation. Thus, these two agencies of transportation will operate to their mutual advantage—either through direct ownership or working agreements. This country cannot and will not remain backward in the transportation of passengers, mail and express by air. Flying knocks at the door of the railroads today!

LIBRARY OF THE AERONAUTICAL ROOM



Tri-motored biplane in use by Boeing Air Transport, Inc., for combined mail and passenger transport.

With this most advanced method of mail transportation will come, logically, the airplane of greatly increased carrying capacity. Planes of the larger type will transport great volumes of mail and a look into the future will reveal that sooner or later this daily load is bound to take mail away from our railway mail service. And, of course, a deeper view into the future will reveal that some day mail of the first class will be carried by air between important centers. This innovation, too, will release large quantities of unutilized space in the mail cars of our railroad transportation systems.

Planes of the future will carry 5,000 pounds of postal matter. And, to make it a real worth-while service, with this enlarged carrying capacity and increased speed of the airplane, there will of necessity be a demand for mail distribution in the air. This departure will obviate delay either at the transfer point or at the point of destination, where the mail can be distributed to individual stations in the city or to large and important commercial and banking houses. This means that an entirely new method in handling air mail will be required by the Post Office Department. The main trunk lines which will be extending east and west, and north and south, will be required to transport heavy loads. Mail thus carried will

Wasp-motored Boeing biplane. This is the type used in mail, express and passenger service between Chicago and Cheyenne.

necessarily be given "treatment" in the air.

I returned recently from a three weeks' inspection trip of the air-mail lines operating in the Northwestern part of the United States. I inspected the air-mail line between the Twin Cities and Chicago, together with that from Great Falls, Montana, to Salt Lake City, Utah, via Helena and Butte, Montana. I also traveled over the trans-continental line from Salt Lake City to Chicago and over a portion of the line from Chicago to Fort Worth, and Dallas, Texas, as far as Kansas City, Missouri. All of these lines are experiencing a very healthy condition so far as business is concerned. I found during my inspection that many concerns are using the air-mail lines for advertising purposes—not necessarily in great quantities of such matter but in small lots. Insurance agents and dealers in small lots of merchandise find the use of the air mail very effective in their respective lines of business. On all the lines I inspected I was very much gratified to note that the passenger service is developing by leaps and bounds. It was marvelous to see how many short-haul passengers the lines are carrying.

I was present at the opening of the international air-mail service between Montreal, Canada, and New York City, and during my visit to Canada conferred with postal officials of that government with respect to the establishment of additional lines between Canada and the United States. At present, a line from Winnipeg to the Twin Cities, in Minnesota, and one from Toronto to Buffalo, N. Y., are contemplated. However, further conferences will be held between American and Canadian postal officials before any decision relative to the establishment of additional lines between the two countries is reached.

Two or three of the air-mail contractors in this country, with whom I talked while on my Northwestern trip, declared that it is their intention to purchase larger equipment to accommodate the steadily increasing business on their lines, resulting from the decrease in air-mail postage which went into effect August first. Their business will reach the normal point during the latter part of October and continue throughout November and December, and they feel that additional planes will be necessary to meet this situation. During my visit to the Northwest, I talked to a group of persons interested in extending the air-mail service between the Twin Cities, Fargo, and Spokane. At Spokane I found the greatest interest manifested toward the projected line, but I informed the delegation that the matter would require careful study and investigation on the part of the Post Office Department and that nothing could be done until assurances were received that the proper lighting facilities could be arranged.

The greatest step forward in the development of the Air-Mail Service was taken last August with the inauguration of the reduced rate on postal matter carried by airplane. No one can accurately anticipate the impetus which this new rate schedule will eventually give to air mail in the way of greatly increased volume. The percentage of increase has already been substantially large but the future will witness even greater increases. Surprising to our citizens must be the information that the Air-Mail Service is now carrying an average of 300,000 letters daily. This should easily be doubled in the near future, in full recognition of the reduced air mail rate and in appreciation of the factor of speeding up the carriage and delivery of a letter. Then, too, I make the prediction that the Post Office Department will be called upon, in conjunction with the operators of the various air-mail lines, to transport large volumes of small packages, weighing one, two, or three pounds. Surface indications support this prediction.

For examples, consider the manufacturers of eye-glass lenses, and film-makers. In the latter instance, air mail will be resorted to in the sending and returning of the individual snapshot work. Also air mail will be patronized by the manufac-

One of the Douglas mail planes which carry mail and express between Chicago and the East over the N. A. T. airlines.

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Model 555—As above, but with leather cuffs with adjustable tabs as illustrated in Aviator's jacket, instead of knitted cuffs. Each $18.50.

No. 700—As illustrated, but in finest brown or grey suede leather. Each $15.50.

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Model 180—Many students find it inconvenient to pay as much as $5.50 for a helmet. The model 180 is an excellent, serviceable helmet at a low price. Made of soft brown lambskin, suedine lined, snug fitting all around, neatly stitched, with adjustable chin strap, and goggle straps. Each $3.00.

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No. 336—Same as above, but of black sheepskin leather. $15.00.

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No. 501B—Split cowhide; black. Per pair $4.00.
No. 501—Split cowhide, cordovan. Per pair $4.00.

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No. 444—Made of finest black horsehide leather, full length, 38 inches to the knees. One piece front and one piece back. Handsome belt. Four pockets, two deep slash pockets and two side pockets with flaps. Warm wool lining. Knitted wristlets inside leather cuffs. $35.00.

No. 445—As above, mahogany horsehide. $35.00.

No. 500—As above, but 34 inches long and only the two slash pockets. Black. Each $27.50.

No. 490—As above, but black sheepskin leather. Each $19.50.

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Model 270—Tan gloveskin, silk moire lined. Extremely light for summer wear. Each $5.50.
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WACO AIRPLANES
MANUFACTURED BY ADVANCE AIRCRAFT CO., TROY, OHIO

turer of small medical instruments; the large wholesale chemists who will be able to supply their customers (druggists) with drugs almost immediately upon receipt of order, dispensing with the necessity for local druggists to keep more or less perishable supplies on hand. Large advertising concerns will use this speedy service for the distribution of their advertising material. And, of course, the ever-increasing army of users of air mail will eventually be added to the many thousands of present-day patrons in appreciation of the reduced letter rate to five cents an ounce—only three cents difference between air-mail postage and ordinary first-class postage when the matter is consigned to carriage by rail.

To repeat, I am asked what is the future of the Air-Mail Service? If we may judge the future by the past, the outlook for the continued growth and expansion of this service has never been brighter. When, a little more than 10 years ago, the Air Mail Service had its small beginning from College Park, Maryland, to New York City, the number of letters carried was only a few thousand—and this scant recognition continued for the first few years. Today, there are 20 air-mail routes in operation and during June of this year 225,000 pounds of mail were thus transported. These 20 air-mail routes extend their ramifications through all sections of the United States—penetrating areas in which 65,000,000 persons reside or more than one-half of our entire population. The longest of these routes—from Chicago to San Francisco—covers a distance of 1,918 miles. The shortest route—from New Orleans to Pilottown, La., and return—is only 80 miles in length. All told, more than 20 air-mail contractors are engaged in servicing the existing routes or have contracted for the carrying of air-mail along the air-ways which have been projected but remain to be inaugurated.

Pilots of the Air-Mail Service—from the first flight on May 15, 1918, to the termination of Government-operation—flew a total distance equal to 634 times around the world. To be more specific, the air-mail planes of the Post Office Department flew 15,850,000 miles. This was 93 per cent of the distance called for by the schedule, and during these flights a total of more than 300,000,000 letters were carried with only .00028 of the amount lost through fire or other agency. These pioneering days were attended by only 32 fatalities or an average of about 500,000 miles for each fatality. The record during the last year of Government operation embraced a flying-distance of two and one-half million miles, with a sacrifice of only one life.

This impressive record together with the auspicious beginning of the Air-Mail Service under commercial contracts augers well for the future. I am so optimistic for the future as to predict that within two years every city of 50,000 or more inhabitants in the United States will be located on one of these air-mail routes. With the accession of each new route or line there is a corresponding increase in the number of cities included in the network. This addition of new routes does not subtract business from the existing lines but contributes to the sum total of air-mail volume to all of the operating companies. I anticipate that in the not remote future the quantity of first-class mail thus carried will be 900,000 pounds a day instead of the present daily volume of 7,500 pounds.

A Brief Historical Survey of Airplane Instruments*

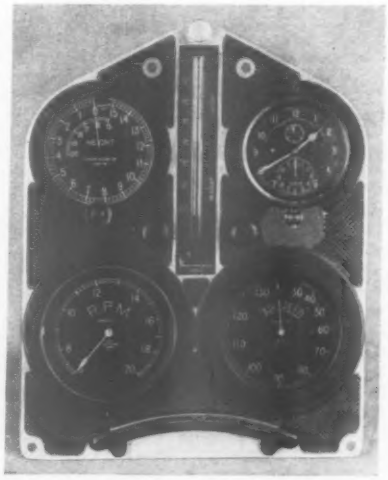
By W. G. Brombacher† and K. H. Beij‡

THE problem of mechanical flight is three-fold in nature and in their perception of this fact, as well as in their skill and perseverance, lay the genius of the Wrights. A machine to fly must not only be capable of sustaining itself; it must also have the necessary elements for control, and there must be a pilot capable of managing the controls. One by one these problems were worked out by the Wrights in the laboratory and on gliders until on that memorable December day in 1903, when they started the motor of their first powered airplane, success was assured.

Airplane instruments find their field of usefulness mainly as aids for the better control or management of aircraft. That first historic airplane flight covered some 120 feet or more in a straight line not far from the ground; hence instruments as aids to control were obviously unnecessary. But as soon as they tried turns, the Wrights found that their unaided senses were insufficient for proper management of the plane, and the first indicating airplane instrument was born. This consisted of a bit of string tied to the cross bar under the front elevator. By its direction with reference to the plane, the pilot could determine whether or not his plane was side-slipping on a turn. It also served to indicate roughly the angle of incidence.

It is interesting to note that instruments essentially recording in nature were carried on the first successful flight, not indeed to aid in

English Instrument Board Dates back to about 1917.



* Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

† Chief, Aeronautic Instruments Section, Bureau of Standards.

‡ Research Associate, Bureau of Standards.

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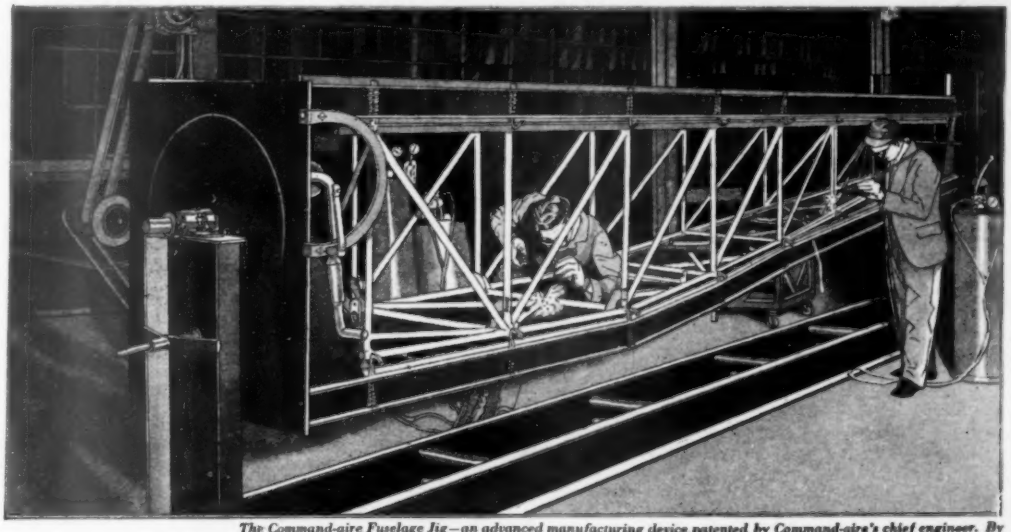

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American Instrument Board
In use at the end of the war. Note use of luminous material on all dials and pointers, and electric light for compass.

flying but to obtain scientific data for checking the propeller calculations which had been based entirely upon theory. Thus the first flight was also the first flight test. The instruments used were a Veeder counter to measure the revolutions of the engine, a Richard anemometer to measure air distance, and a stop watch to measure time of flight. These were installed so as to start automatically when the flight began and to stop simultaneously with the shutting off of the motor on landing.

The striking differences in the instrumental equipment of the early Wright planes and those of today are a direct result of the tremendous progress in airplane performance. Thus, at present, the highest altitude attained is close to 40,000 feet, the maximum speed is about 300 miles per hour and the record endurance is over 65 hours. The oceans have been spanned and continents traversed in single flights. Mail, freight and passengers are carried great distances over regular routes on scheduled times. This involves flying in all kinds of weather by day or by night. The airplane has found its place in aerial photography and surveying, forest patrol, timber cruising, exploration, relief and rescue work, as well as in the varied and difficult army and navy services. A corresponding development of instruments has been necessitated.

And so today we find instruments for almost every conceivable purpose, used not only as an aid to flying but also for flight testing and research purposes. The accompanying table gives a fairly complete idea of the number and variety of instruments to be found on present day airplanes, classified according to type of service.

I. Engine Instruments

(a) Usual Equipment: Tachometer, oil and water thermometers, oil and fuel pressure gages, fuel quantity gage.

(b) Special Equipment: Supercharger pressure gage, fuel flow meter, recording tachometer.

II. Position and Direction Instruments

(a) Usual Equipment: Altimeter, magnetic compass, turn indicator, lateral inclinometer (banking indicator).

(b) Special Equipment: Induction compass, fore-and-aft (pitch) inclinometer.

III. Speed Instruments

(a) Usual Equipment: Airspeed indicator.

(b) Special Equipment: Rate-of-climb indicator, ground speed meter, air logs.

IV. Navigating Instruments

(a) Usual Equipment: Drift sight, clock.

(b) Special Equipment: Sextant, course-and-distance computer, astronomical computer, chronometer, plotting instruments.

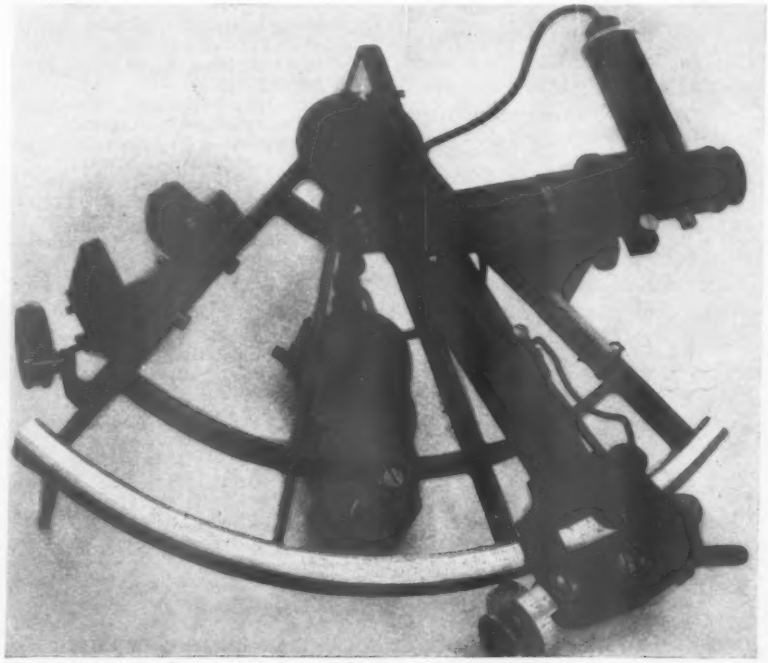
V. Special Purpose Instruments

Barograph, air speed recorder, strut thermometer, oxygen instruments, sensitive altimeter, accelerometer, statoscope, yawmeter, etc.

Nowhere is the progress in instrument development more clearly indicated than by the instrument boards in use. A glimpse into the cockpit of a plane of 1910 would show three or four instruments at the most, a revolution indicator, an altimeter, a clock, and perhaps a compass or an anemometer type airspeed indicator. By 1912 an instrument board was already on the English market, with a pitot-static airspeed indicator, a tachometer or engine speed indicator, an aneroid barometer with both pressure and altitude scales, a clock and two inclinometers. Provision was also made for mounting a compass if desired. But in general the few instruments in use were placed in a haphazard fashion wherever fancy or convenience in mounting dictated.

In 1917 we find British planes equipped with watch, airspeed indi-

Willson Bubble Sextant
The bubble level is attached to the telescope and is illuminated by an electric lamp.



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The man who tunes the plane

Both Are Trained at

Pictures at the left show, from top to bottom: Servicing a Cabin Monoplane; Building up a steel tube fuselage; Students building a new wing; and at bottom, Overhauling a Waco.

Pictures on the opposite page show the Administration Building and two training planes.

All photos taken at Parks Air College

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Thorough Instruction

To be a qualified pilot you must be taught straight flying, acrobatics, forced landings, vertical banks, spins, cross-wind landings, cross country flying, 90 degree, 180 and 360 degree landings and many other flight maneuvers.

But to pass the strict Government examination you must also know aerial navigation, aeronautical meteorology, aerodynamics; be familiar with modern aircraft engines, and be able to rig, overhaul and adjust airplanes!

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Latest type 35,000 foot Navy altimeter with 2¾ inch dial.

cator, inclinometers (usually), altimeter, tachometer, engine thermometer, gasoline and oil pressure gages, compass, and electric illumination. French planes were similarly equipped except that the pressure gages were omitted. Very little attention was paid to the best arrangements of these on the instrument board. Special instruments for bombing, and other war purposes were also available at the end of 1918.

Present-day instrument boards usually include, in addition to the above, a gyro, turn indicator, and a fuel quantity gage. But other differences are noticeable. The size and shape of instrument dials, their graduations, and the arrangement of instruments on the board show the results of careful study. Wherever possible the indicators are made visible at night by radium luminous paint. The attempt is made to attain exactly that degree of luminosity which will not strain the pilot's eyes on the one hand and which will not reduce his ability to see dim objects external to the airplane on the other hand. The compass is an exception to this, being illuminated by an electric light, suitably dimmed.

Early Navy altimeter. It is about five inches in diameter and is an example of the earliest use of luminous material.

The old saying, "There is nothing new under the sun," seems curiously apt in its application to airplane instruments. Most of them show their ancestry. It was natural that when the need arose, instruments already serving similar purposes should be adopted for airplane service. So we find the tachometer, the clock, various pressure gages, and so on, used with little change. The aneroid barometer was fitted with a scale graduated in altitude and transformed into an altimeter. The pitot tube was borrowed from hydraulic work to measure air speeds in wind tunnels and was then fitted to the airplanes themselves. The venturi tube was taken from the same source for the same use on airplanes. The induction compass and the gyro turn indicator are the two outstanding instances of new instruments which were developed for aircraft use, and these have been perfected since the war.

Pre-war development of instruments was necessarily slow. Flight was regarded from the standpoints of experiment and sport, and the specialized uses of aircraft did not exist. The need for only a few instruments was felt therefore, and even the number of these required to meet the demand was so small as not to warrant great expense in development.

When the World War came on, airplanes soon proved their value and the demands made upon them increased by leaps and bounds. An altitude of 10,000 feet could not remain the limit when guns could shoot down a plane at that elevation. Speed increased. Endurance was taxed to the limit on bombing and reconnaissance expeditions. Flight became necessary in all kinds of weather and at night. So we find increasing thought given towards providing instruments not needed previously, and to increasing the range of some and the accuracy of all. Furthermore the severe conditions under which airplane instruments must function became a vital consideration in the development of the instruments. It became necessary to study the effects of vibration, shocks, accelerations, extreme temperatures, and to improve instruments accordingly. The liquid manometer type of airspeed indicator, for example, went out of use on account of its behavior under acceleration. Hitherto unknown errors were discovered, such as the northerly turning error of the magnetic compass. The discovery of the causes of this error led to improvements in the magnetic compass and eventually to the turn indicator and gyro horizons for cloud, fog and night flying.

When the United States entered the war, there was no Army or Navy organization competent to deal with problems incidental to the supply of airplane instruments. The nucleus of such an organization already existed however in the Barometry and Altitude Measurement Section of the Bureau of Standards, which had been working in close contact with the Army, Navy, and Aero Club of America for six years before the entry of the United States into the war. The personnel of this Section was therefore enlarged in the spring of 1917 and its designation changed to the Aeronautic Instruments Section. Its first chief was Mr. M. D. Hersey. The main function of the Section during the war was the cooperation with the military services in writing specifications and devising acceptance tests, and aiding manufacturers in their problems. Information circulars were prepared and test methods and laboratory standards were worked out. Direct contact was maintained with the American and Allied aviation groups in England, France and Italy to aid in the solution of immediate practical problems.

A modern type pitot-static airspeed indicator. This new type is a third smaller than the old, with greater range and better performance.

Since 1919 the Army Air Service has had its own technical organization devoted to airplane instruments,

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As competition in the sale of airplanes increases, Swallow dealers are finding themselves more and more in an enviable position. Purchasers of planes are daily becoming more critical—they are insisting on knowing, not only the reputation of the plane itself, but the character of the organization behind it.

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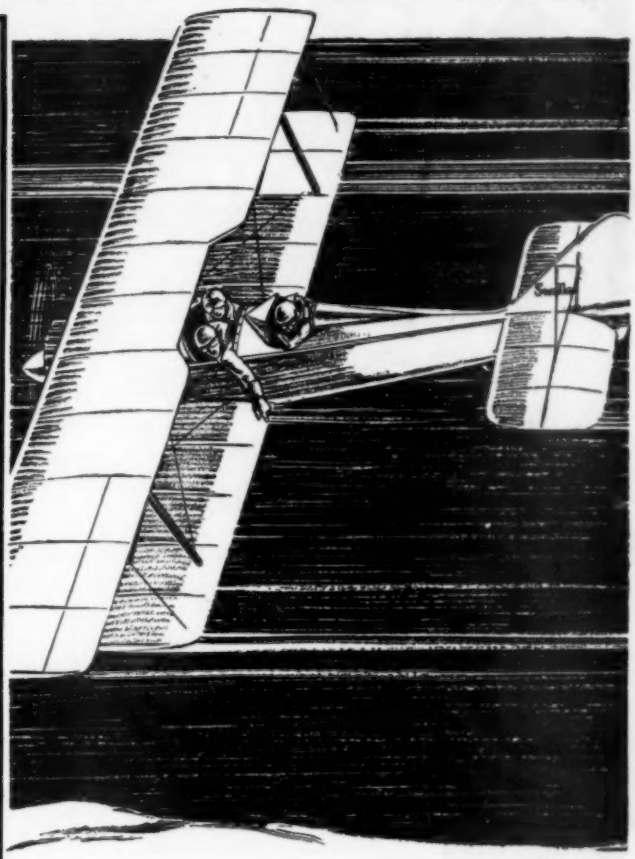

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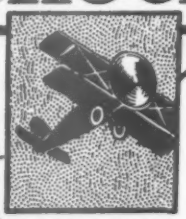

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But the job and the future aren't going to come to you. It's up to *you* to make the move and *claim* them. What's more, it doesn't call for "pull" or for a big outlay of cash to get started in Aviation NOW.

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Walter Hinton

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Hinton has done some of the most amazing things that Aviation has ever seen. He piloted the first plane across the Atlantic—the NC-4. His plane was the original trail-blazer from North to South America. Until he soared over 12,000 square miles of Brazil jungle, no white man had ever seen the Upper Amazon River. Then during the War he instructed "war-birds" who quickly proved the worth of Hinton Training. And NOW—to cap the climax—Hinton Training is available to *every* man who has vision enough to ACT FAST! Furthermore, this tested training dove-tails with your spare-time. You can keep your present job, stay at home, and *prepare yourself* for a real place and a real future in Aviation.

Hinton and companion repairing plane on upper Amazon, surrounded by friendly natives.

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Generator of modern induction compass. This is mounted in the airplane near the tail. Later models are of the rotating surface type.

now located at Wright Field in Dayton, Ohio. The Navy Bureau of Aeronautics also maintains an organization to take care of procurement, specifications and other instrument problems. Largely in cooperation with these and the National Advisory Committee for Aeronautics, the Aeronautic Instruments Section at the Bureau of Standards has carried on and is still engaged in fundamental research on instruments and related problems and development of new types of instruments. A very important activity is the laboratory testing to determine the effects of low temperatures, of vibration, of elastic defects, and other factors. This work has been of great assistance in the steady improvement of instrument performance. The series of reports covering the entire field of aircraft instruments published in 1922 by the National Advisory Committee for Aeronautics should be mentioned.

At the end of the war the world was left with a huge stock of airplanes and accessories. Until this was used up, little progress could be made. It is true that much research was carried out, mainly in government laboratories, but this was not reflected in a commercial way until the war stocks were out of the way. Then rapid progress ensued keeping pace with a really phenomenal development of airplanes.

The improvement and development of instruments were taken up by the more progressive manufacturers. The sizes of the instruments have been standardized and desirable design features have been emphasized. Thus non-magnetic materials are in general use in all parts of the instruments where possible, vibration and acceleration effects have been studied and minimized, and above all the performance and design of such instruments as airspeed indicators, altimeters, barographs and air thermometers have been improved. Centrifugal tachometers have been developed and improved, and it now appears reasonably certain that a revolution indicator of this type will be available which is entirely satisfactory.

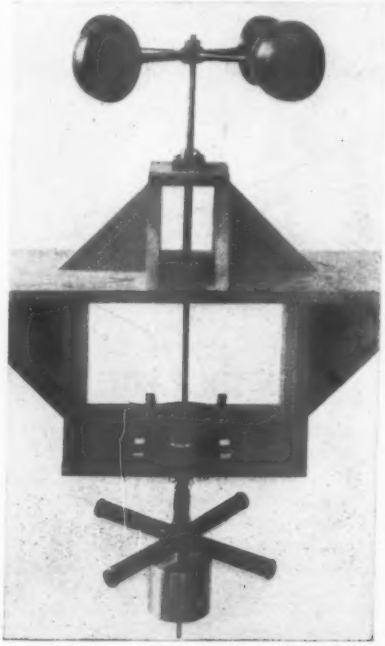
A great deal of credit for recent improvements and new developments must be given to the instrument organizations of the Navy Bureau of Aeronautics and the Army Air Corps who are the largest single buyers of instruments and who have consistently followed the usual government practice of buying only on specification with the consequent tests and tolerances. By specifying desirable improvements in their purchase specifications and by financing in large measure the cost of engineering and development work especially just after 1918 they have contributed materially to the progress which has been made. Some details regarding this are given later in this paper.

Before we consider the history of a few typical instruments, mention should be made of vertical scale instruments. These first appeared about the year 1922 as a result of the initiative of the Air Service and have as their principal object the conservation of space on the instrument boards of multi-motored airplanes. Here three identical sets of engine instruments are needed. With the exception of the tachometer, the length of scale of these instruments can be reduced so as to make a compact unit, since high accuracy and precision are not primary requisites. Thus engine gage units with vertical scales, each containing a thermometer, oil and fuel pressure gages, are generally used in tri-motored planes. Except for the engine gage unit and possibly for the tachometer, the use of vertical scale instruments of other kinds is not increasing. The experience with vertical dials has led, however, to a movement for the reduction in size of the dial and case of many instruments of the ordinary shape, in which the Bureau of Aeronautics is now taking the initiative.

Flight research instruments, almost all photographically recording, have been developed at the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics. These have been almost exclusively used in their researches on the pressure distribution in flight on the various parts of the airplane, the forces developed on the structural members during maneuvers, and many other problems.

The post-war period, and to a less degree, the war period, were marked, not only by efforts to develop and improve service instruments, but by an enormous amount of largely unsuccessful effort on new instruments designed to give much-needed information. Thus a number of experimental models of the integrating and optical types of ground speed indicator were constructed. Many have worked on the problem of securing an improved artificial horizon

The generator element of the 1921 model induction compass. The four-cup propeller placed in the wind stream furnishes the power.



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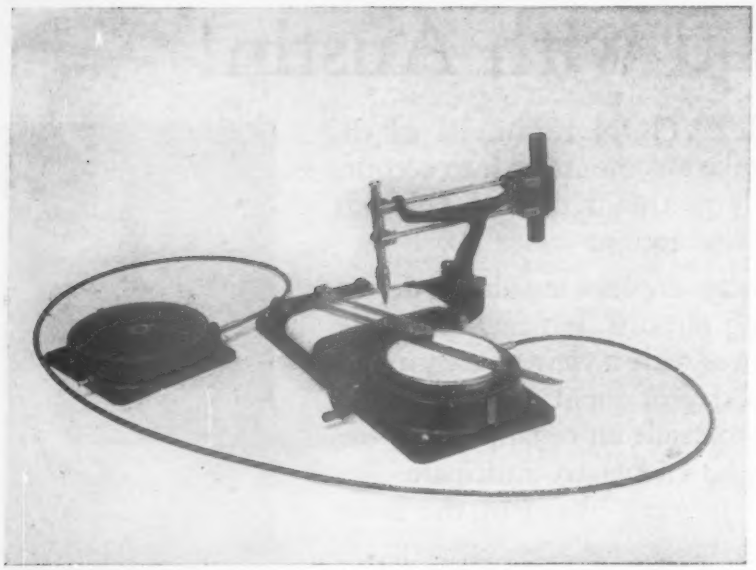


The Navigraphe
Sights through the telescope to the right on objects on the ground are worked out on the circular table, and the course is evaluated on the indicator to the left, mounted in the pilot's cockpit.

for aircraft. Three lines of attack have been opened up in the measurement of the tape-line altitude above the ground, that is, the utilization of electric capacity and the reflection of either sound or electric waves. The first two have achieved a measure of success. Experimental high altitude flying has focussed attention on proper oxygen supply methods and equipment. Automatic regulators have been improved so they are reliable and apparatus has been perfected to use the evaporation of liquid oxygen as a source of supply. Continual but not quite successful efforts have been made to secure satisfactory rate-of-climb meters and statoscopes. Much progress has been made on fuel flow meters and the road indicated to a flowmeter meeting all requirements.

The measurement of airspeed started with the first airplane flight of the Wright brothers, who used a combined anemometer and stop watch, both familiar instruments. As the anemometer gave only the air distance, a calculation was necessary to obtain the airspeed.

In the period between the years 1910 and 1914 many types of airspeed indicators were brought out. That due to Daloz consisted of a suspended sphere the resistance of which to the airstream was balanced by a component of its weight. The deflection of the sphere gave a measure of the airspeed. The Étévé, Maxim and Pensuiti instruments consisted of a plate, broadside to the airstream. The resistance of the plate was balanced by a spring and the deflection of the spring was calibrated in terms of airspeed.

The first use of a venturi tube for measuring airspeed appears to have been in France in 1911. A U-tube manometer served as the indicator for measuring the differential pressure.

The pitot-static tube was in use on aircraft by the British in 1912 with a U-tube manometer for measuring differential pressure.

The pitot-static and venturi tube type soon displaced the other forms, save only the anemometer, because of their greater potential accuracy and ease of reading. The liquid manometer was soon proved unsatisfactory largely owing to the influence of accelerations on its indication. A diaphragm type indicator or manometer was needed. Clift met this need by devising an indicator with a slack leather diaphragm for use with the pitot-static tube. The indicator, devised by Ogilvie had a rubber diaphragm. These indicators were standard equipment on British airplanes through the war period, except at the start.

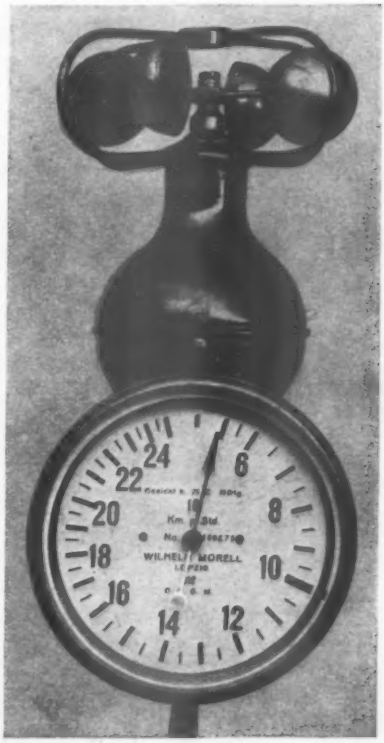
The French, having a greater differential pressure available from their venturi and double venturi tubes, were able to devise an indicator containing a metallic diaphragm which they used during the war period. Experimental instruments were also constructed of the distant indicating anemometer type.

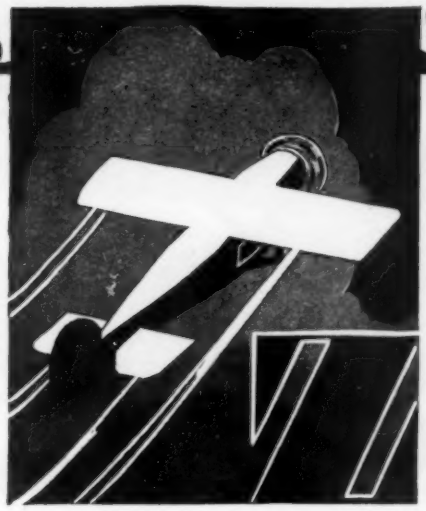
It should be mentioned also that an anemometer combined with a centrifugal mechanism so as to obtain indications of airspeed was employed by the Germans through the war period.

Towards the end of the war research had shown that the venturi tube airspeed indicator requires an altitude correction at low speeds. It was also found difficult to manufacture so that each tube would develop an identical differential pressure at a given airspeed.

The reading of the anemometer type instrument mounted on a strut demands too much effort from the pilot and, what is more important, it indicates true airspeed rather than the more useful relative airspeed since it has a constant value of stalling speed at all altitudes. The pitot-static tube is preferable but the indications of the non-metallic diaphragm type indicator are greatly affected by temperature changes. This defect had been recognized before the end of the war and metallic diaphragm indicators for use with

Airspeed Indicators
German airspeed indicator of the anemometer type. It is mounted on a strut so that the cups are exposed to the windstream. The dial reads in kilometers per hour.





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The new Bakelite case eliminates corrosion and protects the delicate mechanism of the air speed indicator from plane vibration and interference by atmospheric conditions. Ease of reading is insured by the large, well defined figures, the prominent gradation marks, and the tiny spade of the hand.

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"I am much pleased with the results of our tests and compliment you upon the design and construction of this plane.

"Judging from its excellent performance and attractive appearance I shall expect to see a lot of them in the air when we return."

said Lieutenant Bernt Balchen, Chief Pilot for Commander Byrd, after his exacting flight tests of a stock model of the Aristocrat three-place cabin plane.

Commander Richard E. Byrd, one of this country's best informed aeronautical authorities, was equally enthusiastic after he had made his first flight in the Aristocrat, which is the only small plane he has taken on his Antarctic Expedition.

Actions Speak Louder Than Words

Commander Byrd and Lieutenant Balchen chose the Aristocrat in preference to any other small plane in the world in which to repeatedly risk their lives in one of the most hazardous undertakings in the history of exploration.

Follow the example of these aeronautical experts. Play safe!

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Lieut. Bernt Balchen, aeronautical engineer and world famous trans-Atlantic flyer, has flight-tested most of the well-known makes of planes in America and Europe and is recognized as an authority on airplane design, construction and performance.

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The Aristocrat of the Air

The plane you have been waiting for!

The Aristocrat Airplane, designed and built by an organization which contains some of the ablest aeronautical engineers and constructors in the world, has raised the standards of airplane quality and performance to new high levels.

Greater Safety and Dependability

Greater safety and dependability have been attained by providing an ample margin of strength and greater inherent stability and ease of handling.

Involuntary "tail spinning," most frequent cause of air accidents, has been eliminated. It is impossible to hold the Aristocrat in a voluntary "tail spin." At stalling speed, with the engine cut off, the Aristocrat simply assumes its natural gliding angle.

You can fly the Aristocrat "hands off" under normal weather conditions, using only the rudder and throttle for control.

The Aristocrat provides maximum visibility for pilot and passengers.

Better All-around Performance

Better all-around performance has been attained by producing a design scientifically correct and perfectly balanced.

The Aristocrat takes off with a full load in less than five seconds in a normal wind of ten to twelve miles per hour. It climbs 800 feet per minute and has the extremely low landing speed of 36 miles per hour. Its cruising speed is 95 miles per hour and high speed 120 miles per hour.

Lower Cost of Operation and Maintenance

The Aristocrat flies 17 miles to the gallon of gasoline with full load and is designed to permit repairs and replacements with a minimum of time and effort.

Built by Master Craftsmen of the best materials that money can buy, rigidly tested and inspected, the Aristocrat provides the maximum of safety, comfort, performance, durability and economy of operation and maintenance.

In addition to the Aristocrat, we also manufacture a complete line of commercial airplanes of advanced design, including a seven-place plane, ten-place plane, fourteen-place plane and a model designed especially for taking photographs and making surveys from the air.

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A war-time air speed indicator used with a pitot-venturi tube.

pitot-static tubes had been constructed both in England and the United States. These were in production in England in 1918.

In the United States the Zahm pitot-venturi type tube, combined with a metallic diaphragm type indicator formed the airspeed indicator used during the war. Although afterward the pitot-static tube instrument was available, the large stock of wartime instruments delayed its use. The military air services finally began placing orders for airspeed indicators of the pitot-static type, which has clinched its general adoption. The gradual shift to the use of the pitot-static tube type airspeed indicator in both the United States and continental Europe and its improvement, constitutes the major post-war development.

Desirable refinements now relate largely to the installation problems of the tube and its design so that it will not be affected by rain, snow, freezing of rain, and insects.

As has been mentioned, the altimeter is a borrowed instrument, an aneroid barometer mechanism with an altitude scale. Aneroid barometers with both altitude and pressure scales were used by surveyors, mountain climbers and others previously to the advent of the airplane. It is interesting to note that the aneroid was first devised in 1798 for the purpose of measuring the altitude of balloons. As the use in airplanes increased, instruments were made with the pressure scale replaced by an altitude scale. These appeared not later than early in the year 1914. It is interesting to note that some months before the war, an English company offered a 7,000 foot altimeter, the case of which contained an electric light for illuminating the dial from the back. The range of altimeters went up from 10,000 feet at the beginning of war in 1914 to 30,000 feet in 1918, although by far the largest number in service use at the latter date and even much later were 20,000 foot instruments. Except for special purposes, mainly military, instruments having a higher range are not needed.

The performance of altimeters has been greatly improved since 1918, particularly by the reduction of the temperature and elastic errors. One practical effect in the reduction of the elastic errors is that, upon landing after a flight, making due allowance for change of the atmospheric pressure at the ground level during flight, altimeters are now available having a residual error only one-tenth that of the best wartime instruments. Lately the pressure scale has reappeared on altimeters, for use in landing.

A number of special altimeters have been built among which are sensitive altimeters for aerial photography, one with automatic compensation for the air temperature term in the altitude formula, and one with a manually controlled air temperature compensation. An important development for flight test work and one which contributes greatly to its accuracy is that of the double traverse barograph, in which the pen traverses the chart twice.

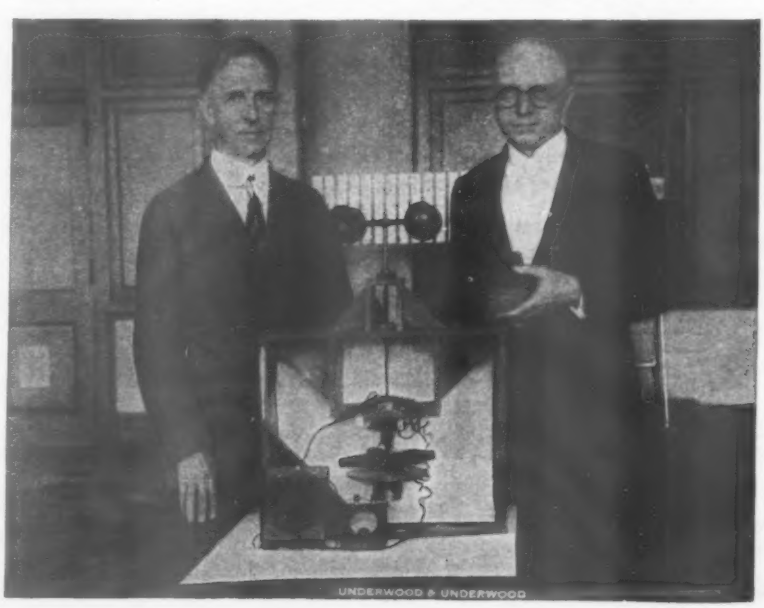
The induction compass, first known as the earth inductor compass, is one of a few instruments primarily developed for airplane service. Its principal advantage over a magnetic compass is that the inductor or magnetic element can be placed far from the engine and its accessories so that the effects of a potent source of magnetic disturbance are avoided.

The first working model was devised and constructed by Heyle and Briggs of the Bureau of Standards as part of the air navigation program of the Air Service. The development work commenced in October, 1920, and the successful model was in operation in 1921. The induction compass had been previously suggested a number of times; several patents had even been granted both in England and the United States. However, no successful working model of earlier date than that of Heyl and Briggs has come to our attention.

Improvements in design and construction were due in large measure to the Pioneer Instrument Company actively supported by the Air Corps. This company first undertook to furnish instruments to the Army Air Service (now Air Corps), in the middle of the year 1922.

It should be mentioned that the

(*Continued on page* 110)



Dr. L. S. Briggs (left), and Dr. Paul K. Heyl (right), with first successful model of the earth inductor compass, which was awarded the Magellan gold medal.

Cessna Facts

The National Air Races proved CESSNA SUPERIORITY—not only over any other cabin ship—but over ALL TYPES.

In Class A, Rowland won. In Class B, Schultz, in his Whirlwind powered Cessna, made the fastest time of any ship, open or closed, carrying a commercial license (or approved type certificate) issued by the U. S. Department of Commerce.

Advanced type of construction and engineering makes possible the tremendous speed of the CESSNA. Even with this great speed, however, the CESSNA, with a Warner Scarab motor, has an average landing speed of only 42 m.p.h., with a pay load of 677 pounds, including pilot, and 45 gallons of gas and 5 gallons of oil,—an average of 3 tests made at Wichita, at an elevation of 1300 feet above sea level. With the J-5 Whirlwind, the CESSNA with the same load showed an average landing speed of only 48 m.p.h., on three tests.

The CESSNA means more speed, greater stability, easier handling, and above all, more comfort for four people, in its luxurious closed cabin.

These are the reasons why CESSNA today is in the greatest demand of any airplane in America —and why CESSNA dealers are "cleaning up."

Wire or write us for the full story. You'll find it very much worth while reading. Act quick—your territory may still be open.

Cessna Aircraft Company

Wichita, Kan.

Bureau of Aeronautics

The Department of Commerce of the United States

By William P. MacCracken, Jr.
Assistant Secretary of Commerce for Aeronautics

THE Air Commerce Act, under which an Aeronautics Branch was established in the Department of Commerce with an additional Assistant Secretary of Commerce for Aeronautics to administer its provisions, was drawn up generally to promote civil aeronautics.

Theretofore, civil aeronautics had had to promote itself. The mere passage of the Act was a clear track signal and flight—commercial and private—has ever since gotten on at an amazing pace.

A net of air routes already nearly covers the whole of the land and international routes are being added; to quote statistics is but to have them exceeded before the quotation is issued; intermediate fields, lighting, radiotelegraphy, radiotelephony, radiobeacons, and weather information are in service or under installation over as much of the system as governmental funds permit; some two-score millions of miles are flown annually by air transport and air services; production of aircraft and exports is doubling; operation of air routes is proving profitable to some of the carriers; a large number of officials and ordinary business concerns are using airplanes in their daily pursuits; aeronautic research is increasingly applied; uniform legislation is progressing; air transportation is being adapted by the railroads, and a transoceanic route is under consideration.

It was the governmental acceptance of civil flight and practical assistance under the Air Commerce Act, however, which laid the "corner stone for the development of civil aeronautics in America."

Governmental aids to navigation, though they must long trail the advance guard of air transportation, provide stimuli to progress of every kind. The Government's regulatory measures are the bases by which we can measure further development of flight in its broadest sense. On these are applied the insurance of all types, which is becoming more readily available at standardized rates and broadened coverage. Government requirements in personnel, equipment and operation make easier the entrance of new capital.

The Air Commerce Act

On July 1, 1926, the Department of Commerce was assigned a new responsibility. By the passage of the Air Commerce Act the Department was charged with establishing and maintaining civil airways, equipping them with intermediate landing fields, beacon lights, radio apparatus, and other aids to air navigation; establishing air-traffic rules; inspecting, licensing and

W. P. McCracken, Jr., Assistant Secretary of Commerce for Aeronautics.

identifiying aircraft; examining and licensing airmen; collecting and disseminating information pertaining to air commerce and the art of aeronautics; investigating and reporting causes of accidents; establishing aeronautical weather service; publishing airway maps; conducting aeronautical research; encouraging the establishment and maintenance of airports and providing for their rating; and in general fostering civil flight and the aircraft industry.

Organization of Commerce Aeronautics

With the appointment of the Assistant Secretary of Commerce for Aeronautics in August, 1926, rapid progress was made in organization, which endeavored to overtake the march of civil air expansion and attack the work at a peak point.

As personnel was secured activities were assigned to five divisions, three of which were created in existing bureaus and two of which were established to function independently of any bureau, all five divisions being under the Assistant Secretary of Commerce provided for in the new act. The work of establishing, maintaining, and operating aids to air navigation was assigned to the Lighthouse Bureau, which established an Airways Division. The mapping of air routes was assigned to the Coast and Geodetic Survey, and a division of Aeronautical Research was set up in the Bureau of Standards. The other two divisions are known as the Regulations Division and the Information Division.

Appropriations

Congress had made available for the fiscal year ending June 30, 1927, appropriations totaling $550,000 of which $300,000 was to be used for aids to air navigation and $250,000 for the remaining activities.

For 1928, $3,091,500 was appropriated for aids to navigation and a deficiency act made available an additional $1,000,000. Under "aircraft in commerce," for regulation inspection, information, research and general, the appropriation was $700,000, with $72,500 more in the deficiency bill. For 1929 the appropriations were $3,659,850 and $702,500 respectively.

Airways

Conferences on navigation aids, in which assembled the industry, governmental agencies and all others interested, initiated the work of this division. During 1927, the first fiscal year, the Airways Division provided lighting facilities for 2,080 miles of airways, and took over at the beginning of the next fiscal year 2,041 miles of airways which had been lighted by the Post Office Department. The 1928 appropriation of $3,091,500 was expended

Aeronautical experts are unanimous in the opinion that Newark Metropolitan Airport is destined to be one of the world's foremost aviation centers . . . Its very location —20 minutes from the heart of New York City—makes its future as an air transportation center of the first rank inevitable . . . It enjoys a "close-in" position rivalled by few other airports in the world. Capitalizing its natural advantages to the full, the City of Newark has expended every effort to make this not only one of the most accessible, but also one of the safest flying fields in the United States . . . Its immediate adoption as a home port or terminus by such leading air transport companies as Colonial Air Transport, National Air Transport, Pitcairn Aviation, Inc., New York Airways and United States Air Transport, Inc., is an indication of the recognition it has already won from aeronautical authorities.

The physical layout of the Newark Metropolitan Airport is ideally suited to safe operation. Two runways, laid out in the form of a cross to take advantage of prevailing wind conditions, each 2,000 feet long and 800 feet wide, provide paved take-off or landing surfaces. An elaborate flood lighting system provides conditions for night operation almost equal to daylight. All nearby wires are laid underground and all water tanks or smoke stacks in the vicinity are plainly marked and lighted at night. Hangar facilities are adequate and designed for quick, easy handling of planes without risk of damage to wings or tail surfaces.

Safety and accessibility have already made Newark Metropolitan Airport an important factor in the growing aviation industry during the very first month of its operation. Further growth will be rapid. Now is the time for manufacturers of aviation equipment to secure adjacent plant sites on attractive terms—and for air services to negotiate to best advantage for field facilities. For complete details, address

DEPARTMENT OF PUBLIC AFFAIRS
Newark, New Jersey

on navigation aids over 4,260 additional miles of airways, a total of 8,381 miles of equipped airways, completed or under contract at the end of the fiscal year. Today, November first, 1928, the airway aids in operation include: 9,070 miles of lighted routes, with 295 intermediate fields, 1,446 light beacons, 49 weather reporting stations, 19 radiotelegraph stations and 3 radio range beacons; 2,442 more miles of equipped routes are scheduled for the balance of the fiscal year 1929, and other radio range beacons and radiotelephone service to pilots in flight will be in operation before next June.

Airways Division personnel totals 664, in which, however, are included 422 light and field caretakers on a whole or part time basis.

Regulations

After a conference with manufacturers, operators, and other interested parties, the Regulations Division drafted the Air Commerce Regulations of 1926, which became effective December 31. After a second and similar conference the regulations were revised during the 1928 fiscal year.

It was obviously impossible during the second half of the first fiscal year 1927 to license or identify all aircraft then operating in the United States. While it was necessary to permit a considerable number of aircraft to operate on temporary authority, it was essential that a sufficiently large force of inspectors be rapidly provided to enable actual inspection and examination of aircraft, pilots and mechanics.

By June 30, 1928, there had been isssued 2,535 licenses for pilots and 2,816 for mechanics, 1,564 aircraft licenses, 1,320 aircraft identifications, and 47 approvals of design.

On November 1, 1928, the figures stood as follows: pilot licenses, 3,792; mechanics, 3,908; licensed airplanes, 2,524; identified airplanes, 1,855.

In its engineering work, the Regulations Division's province is to determine the airworthiness of aircraft and power plants to be used in interstate commerce. At the end of the 1927 fiscal year 9 models of airplanes had been approved and 38 more received certificates by June 30, 1928; 52 others were advised of changes necessary to make them acceptable. Four engines were approved and 2 disapproved. On November 1, 1928, 78 planes had been approved, 10 engines, and 3 propellers. Other airplanes and engines which had previously met Army or Navy service requirements were accepted for license without departmental tests.

Regulations personnel of engineers, inspectors, section chiefs and clerical help totals 119, of which 40 are field inspectors. The available field inspection staff of only 40, with but 12 airplanes available for their travel, is insufficient to take care of the rapidly increasing number of pilots and of new production aircraft when added to the reinspection of existing vehicles.

Research

During 1927 the departmental Research Division at the Bureau of Standards devoted its energy to improving radio directional or range beacons and radiotelephone communication between the plane and the ground. At the close of the year this work had progressed to a point where the equipment was ready for test in service which continued through 1928, on an enlarged scale. Supplementary research brought refinements. Other work included lighting, soundproofing of airplane cabins, airplane controls, welded joints and the testing of aircraft engines for departmental approval.

Mapping

The first airway map of the Department was prepared and published by the Coast and Geodetic Survey in 1927. During 1928 six others were printed, nine completed but awaiting flight check, while five are now in course of preparation. An airway mileage of 3,968 has been wholly or partially mapped in the two-year period. The program adds 5,012 more. A number of changes have been made over previous similar charts and it is believed the current production is unequalled.

Information

During its first year the air information division collected and disseminated a vast amount of statistics and information pertaining to all lines of aeronautical activities, and sponsored four nation-wide tours in the interest of promoting civil aeronautics. In 1928 its promotion work was expanded and 263 cities were visited in aiding the acquirement of airports, in addition to the assistance given by correspondence. On November 1 there were over 1,000 municipal, commercial or military airports and Department of Commerce intermediate fields scattered in every state, with 326 marked auxiliary fields and nearly 900 more proposed airports. The division publishes information bulletins from time to time and issues bi-weekly its "Domestic Air News," the official gazette of Commerce Aeronautics.

The Industry Reviewed

The beginning of the fiscal year 1927 (July 1, 1926) saw the launching of air mail service by private enterprise and announcement of the relinquishing of the government-operated transcontinental route; contracts let for express service between the American Railway Express and the air mail operators; a growing use of the air for correspondence; the inception of general airport construction; a series of magnificent transoceanic and transcontinental flights; and the rebirth of aeronautics as an industry under the Air Commerce Act.

Anticipating the passage of legislation, the Post Office Department had already let domestic air mail contracts to private enterprise; more had been advertised; and at the end of the 1926 calendar year 18 routes had been operated for mail or passengers, or both, and freight; 14 were contract air mail, one was Government operated (transcontinental, including Chicago-New York additional service overnight), and 3 were passenger routes. Over $5,000,000 had been invested in the contract airway system by the air mail contractors for this first year, and the sum was rapidly increased as new routes and new equipment were added.

A year later the number of routes had grown to 30 mail and other routes in operation or contracted, flying 12,517 miles of airways. The daily mileage flown had grown from 16,792 to 27,986. By the end of the 1928 calendar year air mail and transport services will be in operation or scheduled over 20,431 miles of airways with a daily airplane mileage of some 50,000.

During 1927, operation of air routes proved profitable to 8 of 17 firms reporting and there was a small balance on the right side with respect to the entire number. The income to the contractors from mail alone for the calendar year 1926 was $765,549. For the second year it was $2,634,572. At the January-June, 1928, rate the third annual total will be over $5,000,000. In addition to the mail income, the operators have the revenue from taxi and sightseeing trips, express and regular passenger fares.

More than 600 other concerns are engaged in air service work, such as photography, mapping, crop dusting, advertising, flying instruction, and the like, of whose volume of business there is no estimate. It has been

(Continued on page 108)

AT THE HUB of the nation's airways... five minutes by motor car from the Kansas City business district, is an airport that spreads out invitingly to the aircraft fraternity over its entire 687 acres—the largest body of airport land so closely adjacent to a metropolitan business section in the country. Immediately across the Missouri River, within ten minutes of the postoffice, is another airport of 200 acres.

At the hub of the nation's airways... a factor of vital importance to the manufacturers of aircraft and aircraft accessories who seek the most central location for national distribution.

Radiating from Kansas City are the *airways of the nation.* East, west, north, south, southwest, they make winged transportation of mail, passengers and freight a vital connecting link not only with the entire Kansas City territory but with the nation.

Under the fairest leasing plan yet devised for pioneering industries... a plan by which the manufacturer would pay the most reasonable ground rental possible... aircraft and accessory manufacture will develop as a natural consequence of central location and production advantages.

The raw material is here... the labor, low power and fuel costs... *at the hub of the nation's airways!*

A survey that tells the truth about the opportunities for your industry in this market has been prepared. It will be sent to you confidentially, as well as "The Booklet of Kansas City Facts."

Not just a city but an empire

Kansas City advertising does not confine itself to corporate limits. Within the territory are raw materials and manufacturing advantages of a highly diversified nature . . . many within the city itself, many in the smaller cities of this rich area. Kansas City undertakes to tell the story of the *entire territory* to interested manufacturers, realizing that the city prospers only as its outlying territory prospers.

Opportunity Here Awaits These Products

Men's and Women's Clothing ··· Aircraft and Accessories ··· Hosiery ··· Dairy Machinery ··· Steam Fitting and Heating Apparatus ··· Furniture ··· Porcelain Ware Perfumery and Cosmetics ··· Millinery ··· Wallboard ··· Insulated Wire and Cable ··· Moulding of Bakelite ··· Radio Equipment

Chamber of Commerce of

KANSAS CITY

Kansas City, Mo.

Industrial Committee, Room 8
Chamber of Commerce, Kansas City, Mo.

Please send me, without obligation, "The Book of Kansas City Facts."

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The CHOICE *of those*

Laird's un-ending string of air victories prove the high standards of durability and reliability built into each Laird plane.

There's a vital reason when one make of plane so consistently proves the winner in race after race. In the gruelling elimination of contest after contest standard Laird planes have been consistently winning:

First in 1928 Los Angeles Closed Course Event No. 4.

First and Second in Los Angeles-Cincinnati Air Derby.

Both First and Second in the '27 National Air Derby.

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For fast, practical, and dependable air transportation, Laird proves itself outstanding in reliability as well as speed. This *habit of winning* demonstrates Laird's *extra* dependability—the factor that enables you in a Laird plane, to come through when needed.

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The Ideal Model for Commercial Transportation

The Laird cabin-ship has been a major development of the commercial air travel. A constantly increasing number of firms and business executives are finding fast transportation in these safe cabin-ships—enclosed and finished in deluxe comfort. We welcome the opportunity of offering free demonstrations to responsible parties.

PROFITABLE DISTRIBUTOR FRANCHISE OPEN

In a few open territories Laird's Distributor proposition offers unusual opportunity to parties with air-port facilities and funds to handle the sale of Laird Commercial planes.

The growing list of Laird owners is a gratifying sign of recognition from those best qualified to know.

E. M. LAIRD AIRPLANE COMPANY, 4500 W. 83rd St., Chicago, Ill

Not connected in any way with any other manufacturer of airplanes. Laird Planes are made only at the E. M. Laird Company factory, Ashburn Field, Chicago, Ill.

Development of Aviation Engines

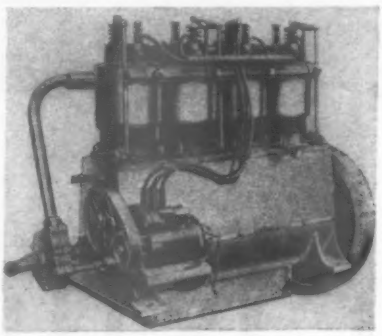
By T. C. McMahon
Chief, Technical Data Branch, Materiel Division, Air Corps, Wright Field

As we celebrate the twenty-fifth anniversary of flight, the major portion of the honors fall to the airplane. The engine, without which we would still be experimenting with gliding, has received but little public attention.

When the Wright brothers had progressed with their gliding experiments to the point where they had solved the principle of control, it became necessary, if airplane flights were to amount to anything more than an exciting sport, to install a power plant light enough to be carried in the air and powerful enough to propel the craft in horizontal flight.

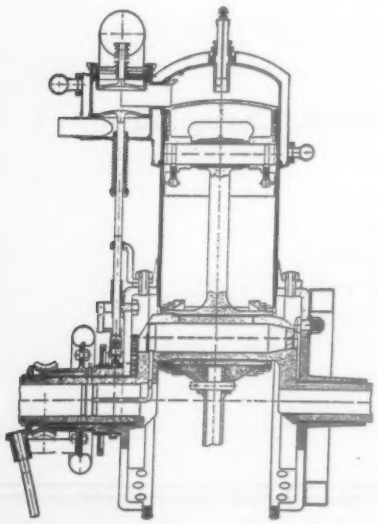
While the internal combustion engine of twenty-five years ago had been developed to a relatively high degree, its satisfactory use in the automobile field offered little comfort to the Wrights, when they considered that the then available engines weighed from fifteen to one hundred pounds for every horsepower developed.

The requirements of an aircraft engine—minimum weight and maximum reliability—were so diametrically opposed, that the power situation looked as hopeless as the airplane itself. When the weight had been reduced to fifteen pounds per horsepower, any additional weight reductions indicated a senseless sacrifice of reliability. The sacrifice of reliability could be borne with less serious results in the motor car than in the airplane. The problem of flight reached an impasse with the unavailability of a satisfactory engine, so it was necessary for the Wrights to enlarge their field of research to include the aeronautical engine.



Early Wright airplane engine, 4 cylinder, water-cooled.

Longitudinal section of the Manly engine, a very early radial type.



It was a staggering problem—an engine which must operate at nearly all times at full throttle, with a reliability paramount to life assurance, and the weight reduced to one-third of the best automobile practice.

Men with the temerity to attack what was still considered to be the impossible problem of flight, could not be stopped by the impossible in engine design.

The Wright brothers' first power plant was a four cylinder water-cooled vertical, with a displacement of about two hundred and forty cubic inches, and it was a success! The bore was 4⅜ inches and the stroke 4 inches; at 1,200 revolutions per minute it developed 30-35 horsepower and weighed approximately 180 pounds. This first attempt at aircraft engine design produced an astonishing saving in weight, and brought the power loading down to about six pounds per horsepower.

The cylinders were cast iron, with sheet aluminum water jackets. The crankcase was of aluminum alloy with the oil sump in the case. Measured fuel injection into the manifold was employed in place of a carburetor, and for the sake of simplicity and lightness automatic intake valves were used, although considered obsolete in automobile engine construction. Ignition was furnished by a high tension magneto. The crankshaft was machined from a solid billet of steel and provided with a flywheel. Sprockets for chain driving two propellers were provided forward of the flywheel.

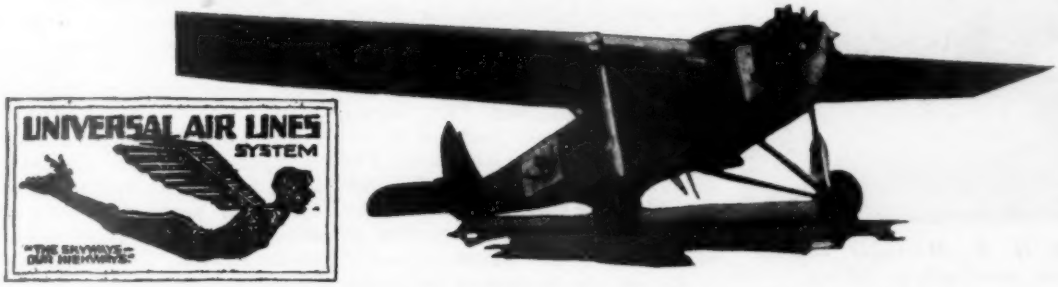
This innovation in engine design, with its enormous saving in weight, should stand out in history on a par with the airplane itself as a signal achievement, and a very large contributing factor in the success of the 1903 flying demonstrations.

There was no sacrifice in reliability, for the engine was used repeatedly by the Wright brothers in flight, and similar engines with only detail changes were flown satisfactorily in America and Europe. The engine was freely copied by designers of both continents for years.

Coincident with the development of the Wright brothers' engine, Charles M. Manly was designing and having constructed for Professor

The first Curtiss 8 cylinder engine, 1909.

TRAVEL THE SKYWAY!



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DAILY SCHEDULE

TWIN CITIES—CHICAGO DIVISION

SOUTHBOUND READ DOWN	AIRPORT	NORTHBOUND READ UP
12:00	Lv. ....Minneapolis.... Ar.	12:30
11:40	" ....St. Paul.... "	1:20
3:30	Ar. ....Chicago.... Lv.	9:00

Light face figures A.M. Heavy face figures P.M.

Universal Air Lines Bus, connecting with SOUTHBOUND plane, leaves 829 Marquette Ave., Minneapolis, at 11:05 a. m.; 339½ Wabasha St., St. Paul, 11:25 a. m.; Bus for NORTHBOUND plane, leaves 103 W. Monroe St., Chicago, at 9:10 a. m.

CHICAGO-CLEVELAND DIVISION

EASTBOUND READ DOWN		AIRPORT	WESTBOUND READ UP	
a.m.	p.m.		a.m.	p.m.
8:40	4:00	Lv....Chicago (c.s.t.)....Ar.	8:35	5:15
12:15	7:45	Ar...Cleveland (e.s.t.)...Lv.	6:50	3:30

UNIVERSAL Air Lines Bus, connecting with EASTBOUND plane, leaves 103 W. Monroe, Chicago, at 7:20 a. m. and 3:20 p. m.; WESTBOUND plane, leaves Cleveland Hotels, Cleveland, at 6:10 a. m. and 2:50 p. m.

Robertson Aircraft Corp. operates these two divisions of Universal Airlines System.

CHICAGO-ST. LOUIS

SOUTHBOUND READ DOWN	AIRPORT	
9:00	Lv. ....Chicago.... Ar.	3:30
12:15	Ar.....St. Louis.....Lv.	12:30

NOTE: This Division is operated with Tri-motored airplanes.

ST. LOUIS-KANSAS CITY

WESTBOUND	AIRPORT	
2:15	Lv.....St. Louis.....Ar.	11:10
5:00	Ar. ....Kansas City.... Lv.	8:30

NOTE: Until larger, faster equipment now ordered is available, we are operating this Division with four-passenger capacity airplanes.

(Rates Include Universal Air Lines Free Bus Service to and from Airports)

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Plane to Pittsburgh, via Ball Airlines, leaves Cleveland after arrival of our morning plane.

To Albany, via Colonial Airways, leaves Cleveland 12:20 p. m.; arrives Albany 6:15 p. m.

WEST BOUND

Passengers from New York and Boston arriving at Cleveland on the *"Southwestern Limited"* make immediate connection with our planes for Chicago, Minneapolis, St. Louis and Kansas City.

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Universal Air Lines System

260 H. P. Mercedes engine, used extensively in the war.

Langley's flying experiments, a five cylinder water-cooled fixed radial engine of 540 cubic inch displacement. With a bore of 5 inches and stroke of 5½ inches, it developed 52.4 horsepower.

Its weight of 150 pounds (2.86 pounds per horsepower) should have called the attention of aeronautical engine designers to the weight saving advantages of the radial engine.

Although Mr. Manly's engine was years ahead of its time, it had little influence on the evolution of the aero engine, probably because of the fact that the first successful flight was made with a vertical engine, and automobile engine development was following similar lines.

The cylinders of Manly's engine were of the "L" head type, built of sheet steel with pressed-in cast iron liners, and sheet steel water jackets welded on. Like those of the Wright engine, the intake valves were automatic, and the exhaust valves positively actuated. The connecting rods were the slipper type with tubular section except the master rod which was solid. High tension battery ignition was used.

The excellence of Manly's engine was never fully appreciated, and the advantages of radial design received little opportunity to prove themselves until after the war.

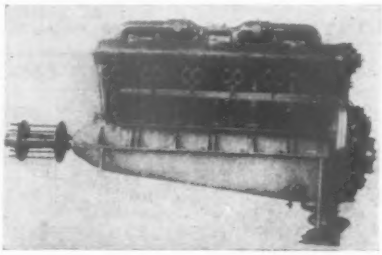
The demands for increased power and reduced specific weight resulted in the addition of cylinders to the four-cylinder vertical engine, and the early appearance of the eight-cylinder "V" type engine.

The Wright brothers added two cylinders to their engine and reduced its specific weight to 4.6 pounds per horsepower, and shortly afterward used the same cylinder design (with positive intake valve, however) on an eight-cylinder "V" type engine with still lower specific weight.

Glen Curtiss, who for some time had been developing motorcycle engines, produced a four cylinder, vertical, air-cooled engine, but almost immediately substituted for it an eight cylinder "V" type air-cooled engine, and shortly thereafter replaced the air-cooled "V" type with an eight cylinder water-cooled "V" engine which in its major features he retained for a number of years. The celebrated Curtiss OX engine produced in large quantities for training airplanes during the war, was an outgrowth of this engine.

Abroad, the horizontal two cylinder opposed engine played a more important part in early aviation than it did in this country, and a considerable number of pioneer fights were accomplished with such engines.

The Darracq twenty-four horsepower water-cooled engine, with a weight of five pounds per horsepower



Renault engine, 12 cylinder, V-type.

and the Duthiel-Chalmers twenty horsepower air-cooled engine which Santos-Dumont used in his Demoiselle were the most successful early representatives of the type in Europe. They were followed by larger engines of similar design by the same makers, and by similar engines of Clement Bayard in France, Palons and Beuse in Germany and Alvaston in England.

The early aero engine development in Europe was largely in the hands of men like Daimler and Renault, successful automobile manufacturers, Levasseur, who built the Antoinette engine, and Green in England.

The two cylinder vertical Daimler engine of 1897 was the real forerunner of the later highly successful Daimler and Mercedes-Daimler engines. The first Daimler engine designed for aviation service, however, was a four cylinder vertical engine of eighty-five horsepower with overhead valves and cylinders in pairs.

Beginning with a four cylinder vertical engine of power and dimensions similar to the first Wright engine, Renault rapidly produced several four cylinder vertical and eight cylinder "V" type engines with both air and water cooling.

The most successful of his early engines, however, was the air-cooled eight cylinder engine used in the eight hour flight of Tabuteau in 1910.

The Antoinette engines were built in eight, sixteen and thirty-two cylinder types, with fuel injection into individual posts and with cooling effected by the evaporation of water in the jackets. The steam was condensed in the radiator.

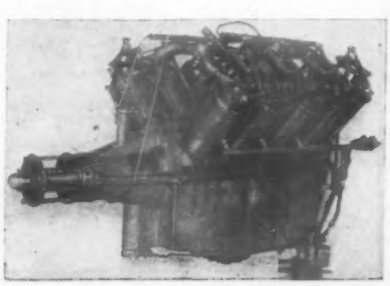
The Green engine development was initiated in England with a four cylinder vertical engine with a piston displacement approximately that of the first Wright engine, developing about forty horsepower at 1,200 revolutions per minute.

A similar engine of sixty horsepower was produced shortly afterward, but was displaced by a six cylinder vertical engine of one hundred and twenty horsepower at 1,250 revolutions per minute.

Fixed radial engines were given their early impetus largely from the continent. After Manly's engine for Professor Langley's "Aerodrome" little promising radial engine development occurred in America for several years. Abroad, however, the Anzani engine came into early prominence in Bleriot's flights and a twenty-five horsepower three cylinder air-cooled engine of that make was the first to cross the English Channel. The Anzani production developed rapidly and includes in a relatively short time radial engines of three, five, six, seven, nine, ten and twenty cylinders with both air and water cooling. The fixed radial type was represented later by the Salmson water-cooled engine and in 1914 six sizes ranging from the ninety horsepower, seven cylinder engine to an

(*Continued on page 70*)

Curtiss OX 5, eight cylinder, V-type.



AS EXPERTS SEE US

J. Warren Smith, McKeesport, Pa., nationally known air mail and transport pilot, passes judgment on the Travel Air Cabin Monoplane.

When J. Warren recently visited the Travel Air factory to take delivery of two Travel Air planes for mail service on the Ball Air Mail lines, he had his first chance to thoroughly inspect, test and fly a standard production Travel Air Cabin Monoplane.

And this is what he said:

1—The same wonderful control in a "Stall" is found in this Monoplane as in all Travel air biplanes. This is especially remarkable in a Monoplane. There is plenty of "Lateral" when you need it.

2—Has the same wonderful load factor and take-off as in all Travel Airs. Load it down, get in the air and you don't know you have a load. Take-off and landing ability in small fields truly remarkable.

3—Consideration given everywhere for lubrication, such as landing gear joints which have bushings and hollow bolts for Alemite oiling: Saves expensive replacement. Gives new landing gear struts for the price of a 25c bushing. All control joints constructed for ease of lubrication.

4—Landing gear bolt corrugated on end to prevent turning; forces friction and wear onto the bolt and bearing; allows the oil to go where it should go.

5—Cross section of wing ribs of wood with grain in separate directions to hold its stiffness; prevents any change in wing curve due to dampness.

6—All nails, tacks and screws plated to prevent rust.

7—Cap strips in wings put on with screws to allow for vibrations and not stick through fabric.

8—Lots of "Dope" around the Travel Air factory; dope enough not only to tighten and finish but to keep linen tight all the time.

9—No hammer or chisel marks anywhere. A finished job in the finest of workmanship.

10—Cabin seats built with consideration of comfort of passenger. They fit the occupant.

11—Pilot's seat so comfortable can fly for 4 to 5 hours without getting tired.

12—Experience built into every detail even to a leather map case right at the pilot's seat.

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14—"And of course all proven factors of Safety and Dependability are incorporated in this new Travel Air."

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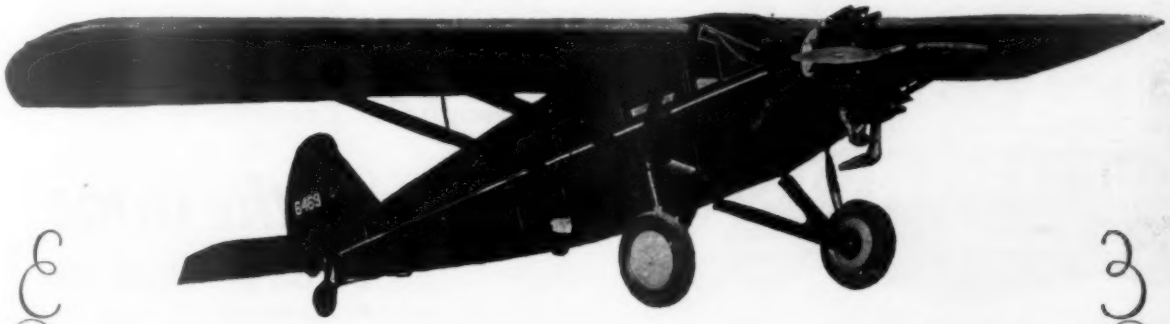

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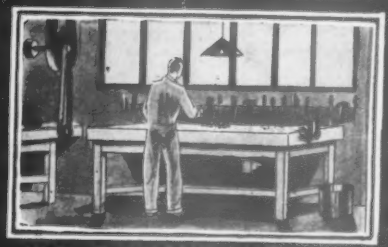

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You don't need advanced schooling, or a lot of mathematics to qualify. George Smith didn't even finish the grade schools. Today he is making $110 a week as an aviation mechanic.

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You get personal flight instruction under famous aces. Only U. S. Licensed instructors and planes are used. You learn everything about aviation including navigation, plane construction, motor repairing—everything necessary to fit you for BIG PAY.

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Already the ASPA has organized over 400 civilian flying clubs throughout the United States. But we need more. Many more. And we need you! Helping to carry on this work in your community!

For The American Society for Promotion of Aviation will petition Congress to appropriate $40,000,000 to supply **gratis** airplanes to every organized aero club of fifty members or more.

In doing this, we are simply urging Congress to follow, without delay, in the footsteps of the Canadian Government, which supplies an airplane gratis to every civilian flying club. In fact, Canada goes further than this—for Canada pays each club $100 for every pilot turned out.

$40,000,000 Jokes

$40,000,000 will provide 10,000 modern airplanes for training purposes. This is less than the cost of a first class battleship. And as an editorial in one of America's greatest newspapers recently pointed out—battleships are fast becoming a joke. *What this country needs, and hasn't got, is the world's best fighting AIR Fleet.*

What the ASPA Is

The American Society for Promotion of Aviation was organized by 12 ex-service aviators at the Army & Navy Club, New York City, in 1925. It is a voluntary non-profit organization incorporated and maintained

To "Arouse and promote interest in aviation, as our strongest army of National Defense."

To make America air-minded—to cooperate with air-craft manufacturers in building up this newest industry—

To organize civilian flying clubs throughout this country and to help train pilots for national emergencies.

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which covers the cost of silver wings, membership card and literature of The American Society for Promotion of Aviation.

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N. Y. City

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Yes I am interested, and I want to add my name to the thousands already enrolled by you in your petition to Congress to provide funds to furnish airplanes gratis for civilian flying clubs, organized under the auspices of the ASPA or other accredited aviation organizations. Dept. PA.

Name.....

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City..... State.....

(*Continued from page 66*)

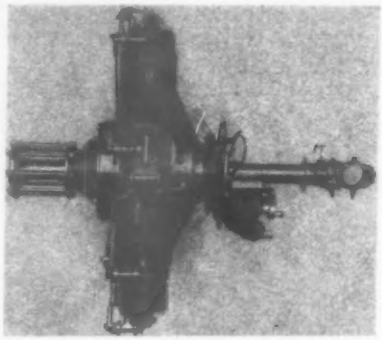
eighteen cylinder six hundred horsepower engine were in production.

The first successful rotary engine development occurred in the United States, initiated by the Adams Company in the commercial construction of an engine originated by F. O. Farwell for automobile propulsion. And the principle was applied under the direction of Emile Berliner in 1907 to a horizontal rotary engine to be used in his helicopter.

The same type engine (with cylinders in a vertical plane however), was soon constructed for airplanes and shortly afterward the Gnome engine of Laurent Seguin appeared in France, employing largely the construction successfully demonstrated in the performance of the five cylinder Adams-Farwell engine.

Mr. Berliner also fostered the design of the Gyro rotary engine which employed a piston head intake valve operated by the oscillation of the connecting rod and with a mechanically operated exhaust valve in the cylinder head. That construction was subsequently modified by the substitution of a duplex port valve in the cylinder wall, uncovered by the piston and acting as either intake or exhaust valve under the control of an auxiliary piston valve.

The first successful European rotary engine to appear was the Gnome invented by Laurent Seguin, first represented by a thirty-four horsepower, five cylinder air-cooled engine. A seven cylinder sixty horsepower engine of similar construction shortly displaced it and by 1913 eight different sizes were being produced with seven, nine, fourteen and eighteen cylinders and ranging in horsepower from 45 to 180. The famous Gnome "Monosoupape" with intake port uncovered by the piston and mechanically operated exhaust port, appeared in 1913 and played an important part in the World War. The LeRhone and Clerget were later



Le Rhone radial, 9 cylinder engine, 180 H. P. engine.

European developments of the rotary type. Both were of conventional design and gained considerable prominence in military service. The windage loss, gyroscopic effect and high fuel and oil consumption of the rotary engine, however, appear to more than counterbalance the advantages of light weight and simplicity of operation and the rotary engine has almost disappeared from the flying fields in this country.

It would seem that every conceivable arrangement of cylinders has been tried in aircraft engine development, both air and water cooled and in combination from two to thirty-six cylinders. There are verticals, Vees, double Vees, W's, Y's, and X's. Then there are the Rotaries, Barrel Rotaries, Differential Rotaries and Double Rotaries, Radials, Horizontal Radials, and Horizontally opposed types.

The vertical eight branched off into a double row of cylinders with two crankshafts, but the most radical departure from the conventional design was the five cylinder tandem, double acting two cycle engine built by Dufaux in France. It was the equivalent of an ordinary twenty cylinder engine operating on the four stroke cycle.

Whatever the cylinder arrangement adopted the engine weight is again seriously affected by the means of cooling employed. Water-cooling, like the line engine, enjoyed a long tenure of popularity, chiefly because of priority of development. The air-cooled engines were early in the field, it is true, and were rather successfully built for low performance by Curtiss and Renault, and in radial form by several others, but the manufacturers were easily frightened by the thermal and mechanical difficulties encountered and were readily persuaded to adopt water-cooling even at the cost of additional weight for cooling water and radiator.

By 1914 the air-cooled engine developed in Europe was far ahead of the United States, as evidenced by the fact that France alone had 13 engines from which to select, 10 of which were air-cooled. Six of these were rotaries, two were radials, and two were vees. Of the water-cooled engines, two were radials and one was a vee. The power of these available designs ranged from 80 to 200 horsepower.

Most of those engines would not stand up in military service and in a short time the number in favor was reduced to five and a little later to two, leaving only an 80-horsepower air-cooled vee and the 130-horsepower water-cooled radial.

(It is interesting to note that the cooling system is reversed as to engine types in present engine construction. Radials are air-cooled and vees are usually water-cooled)

A very critical situation was presented. The airplanes were found inadequate, and manufacturers were demanding more powerful engines.

At this time the German Mercedes engine surprised the aviation world, and when several of them were captured intact, by the Allies, they were placed in the hands of engine designers with orders to copy and produce a similar engine, and another more powerful.

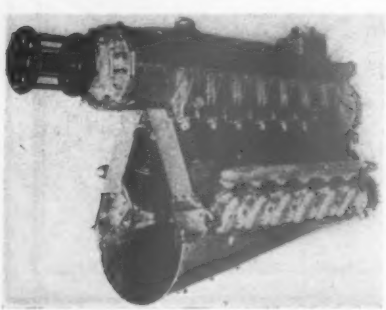
On March 2, 1915, three specified types of airplanes were demanded, and the following motors were officially placed at the disposal of the airplane constructors:

LeRhone or Clerget, 120 h.p. rotary.

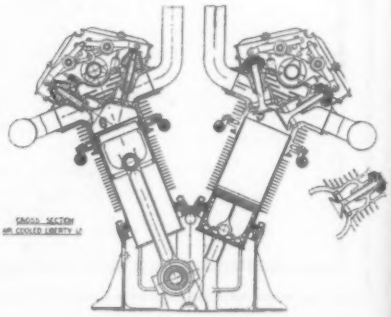
Renault (Mercedes type), 110 h.p. 6-cyl., vertical.

(*Continued on page 74*)

Inverted Liberty engine, 12 cylinder, geared, and air-cooled.



Cross section of Liberty air-cooled engine, 12 cylinder, V-type. This motor has a displacement of 1,410 cu. in., and produces the same power as the water-cooled type, due to higher cylinder pressure and higher r.p.m.



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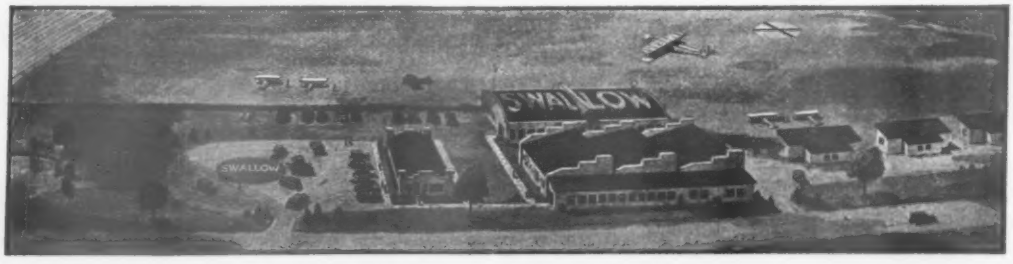
From this small beginning, however, has grown Wichita's present dominating position in the industry. The past year's growth has been stupendous. From approximately 100 employees, producing some 300 planes in 1927, to 841 employees at the present time, and an estimated production of some 1500 planes, with a value of nearly $8,000,000 in 1928,—nearly one-fourth of all the commercial airplanes made in America this year will come from Wichita's factories. The whole world is Wichita's airplane market. Over nearly every civilized country, Wichita made planes are now flying.

To men who have a vision of the marvelous future of this business, Wichita has much to offer. Our many factories require vast amounts of materials, steel tubing, dope, airplane linen, accessories and parts of all kinds—and of course, most important of all—MOTORS.

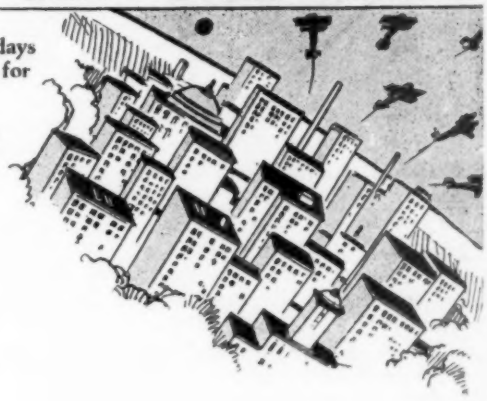
We invite inquiry from responsible men planning to enter any phase of the aircraft industry. Full details will be sent upon request.

Chamber of

Wichita



THE AIR CAPITAL



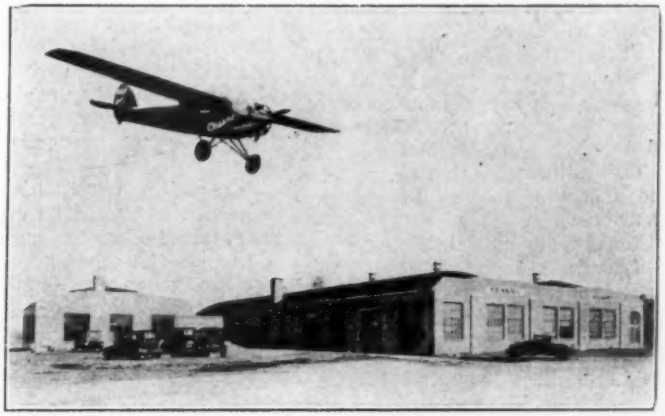
Wichita's climate is ideal, with no fogs and real flying weather 365 days of the year. The vast Kansas Plains are one unending landing field for a hundred miles or more in every direction.

All Wichita is air-minded. This is evidenced by the recent addition to the curriculum of Wichita University, of a Chair of Aeronautics, offering one of the most complete courses of study to be found in any of America's Higher Schools of Learning. Wichita also has seven other schools of aviation, one National Air-Mail Line, and one Passenger and Express Air-Transport Line. Other products affiliated with the industry, manufactured and marketed nationally from Wichita are:

Flying Suits, Shock Absorbers, Radiators, Propellers, Motors, Airplane Batteries, Brass and Aluminum Castings, Sparkplugs, Puttees, Leggings, and Boots, Airplane Sirens, Hangars, Gas Tanks, Welding Equipment, Airplane Gasoline, as well as one of the largest jobbers of Aircraft Steel in the country.

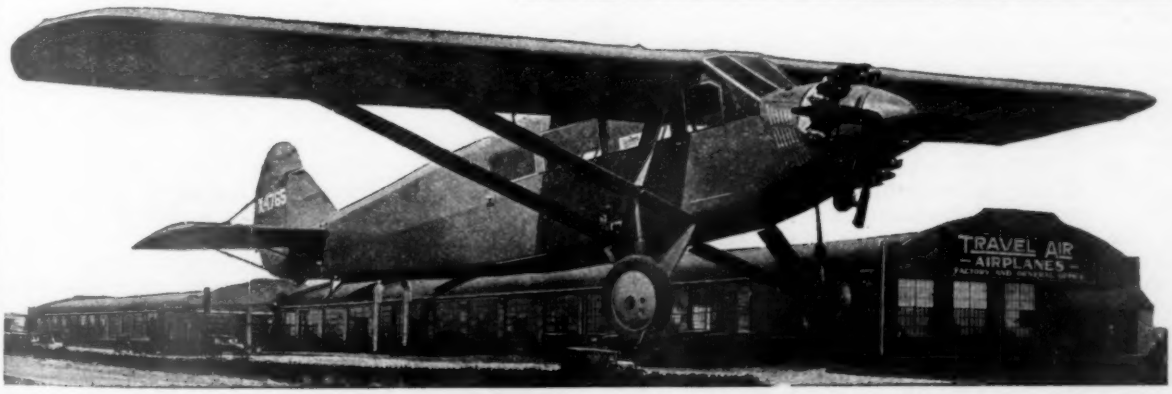
Wichita's Airplane Manufacturers, all in active production at the present time, include:

TRAVEL AIR MANUFACTURING COMPANY
SWALLOW AIRPLANE COMPANY
STEARMAN AIRPLANE COMPANY
CESSNA AIRCRAFT COMPANY
SWIFT AIRPLANE COMPANY



Commerce

Kansas



Front view of 24 cylinder Liberty, X-type, water-cooled.

Berliet (Mercedes type) (Automobile Co.), 110 h.p., 6-cyl., vertical.

Lorraine Dietrich (Mercedes type), (Automobile Co.), 110 h.p., 6-cyl., vertical.

Renault, 200 h.p., 12-cyl., Vee.

Salmson, 160 h.p., radial, 9-cyl.

Salmson, 200 h.p. radial, 9 and 14 cylinder.

Clerget, 200 h.p., 12-cyl., Vee.

No returns were obtained from the above demand and the situation remained as before.

Under date of August 3, 1915, invitations were extended to all constructors to take part in a "concours" which would commence on October 1, 1915.

The military authorities offered the following motors to the constructors:

Renault, 80 h.p. air-cooled.

Renault, 110 and 200 h.p. (Mercedes type).

Berliet, 110 h.p. (Mercedes type).

Salmson, 150 and 200 h.p.

Due to the fact that not one of the "entries" were ready for the "meet," it was put off until November 1, 1915.

These trials occupied the entire month, and although actual results were not satisfactory, a great deal was learned and the demonstrations served to illustrate the difficult task that was before the constructors.

Following this, the authorities officially approved and designated the 200 h.p. Renault Mercedes motor as the desired motor.

At the beginning of the year 1916 every effort was put forward to increase the output of the 200 h.p. Renault. This continued for some months while the constructors were trying to develop an airplane, either single or multiple motored, to answer the military requirements, but without success. It was not until hundreds of these motors had been built that the military authorities realized that there were no airplanes capable of mounting these motors, although their power by this time had been increased to 250 h.p.

Fortunately the rotary motor constructors, disregarding the instructions that the rotary type was not desired and would not be accepted, continued their development, and it was through their efforts that the aviation service was able to hold its own.

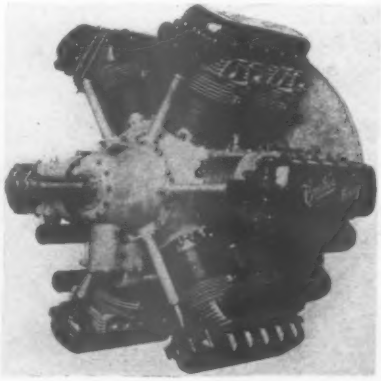
When the United States entered the war in 1917 there was practically no aero engine industry in this country, with the exception of the Curtiss factory, which was manufacturing training engines on Allied war contracts, and the Wright-Martin Aircraft Corporation, manufacturing Hispano-Suiza engines under license.

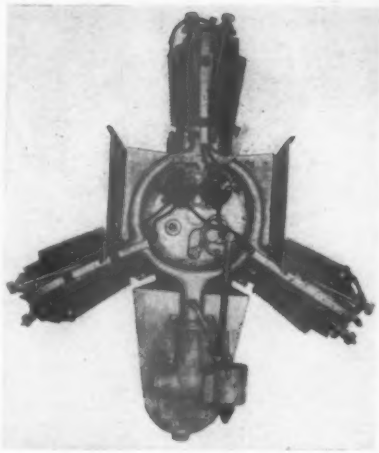
The Hall Scott Motor Co. of Berkeley, Calif., and the Sturtevant Company of Boston, Mass., began construction of aircraft engines in 1911, but their engines as a whole were not placed in production in the war program.

The cry for additional power made it evident that the available equipment in this country could not possibly meet the demands. The manufacturers were faced with the necessity of producing an engine of much greater horsepower, which must also have unlimited production possibilities.

The Allies, up to this time, had expended efforts on 60 different designs and had gotten nowhere. Germany, on the other hand, had concentrated largely on one design, and had the outstanding engine of that period.

Curtiss H-1640 Hexagon engine, ¾ front view; 12 cylinder, air-cooled.





Rear view of 3 cylinder radial air-cooled Lawrance motor.

The United States, as a Government, was in a position to assemble all the data and experience of domestic and foreign designers, which would have been impossible under the usual competitive commercial method.

The designing of an entirely new engine could be carried out more expeditiously in this country than an attempt to place in production an existing foreign engine with all the differences in design and manufacturing methods.

The servicing and repair, at such a great distance from the seat of manufacture, could only be satisfactorily accomplished by standardized, interchangeable parts. The engine desired could only be obtained by pooling all resources and knowledge in one supreme all-American effort.

Colonel E. A. Deeds, of Dayton, Col. Sidney Waldron of Detroit, J. G. Vincent, Chief Engineer of the Packard Co., and E. J. Hall of the Hall-Scott Co. discussed such an engine with Gen. Squier, then Chief Signal Officer, and others.

Detailed proposals were presented to the Aircraft Production Board, and the joint Army and Navy Technical Board, which immediately approved the project.

Witness the birth of the Liberty engine. The creation of this powerplant constitutes a speculative, fearless attempt by American designers and manufacturers to produce in large quantities an intricate mechanism superior to any other engine produced in any other country. The publicity attending its conception fancied the winning of the war

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It deals with modern aircraft engines and miscellaneous equipment, such as carburetors, magnetos, starters, aeronautic instruments, etc. It also includes types of aircraft, controls, nomenclature for aeronautics and complete information pertaining to air commerce regulations, etc. Adequate space is devoted to the Wright "Whirlwind," the "Wasp," the Curtiss, Packard (including the monster X-type 24 cylinder engine), the Fairchild-Caminez (the engine without a crankshaft or connecting rods), and other leading makes, including some of the foreign makes of engines.

One of the big features is the 400 illustrations, many made especially for this book, including master charts with reference figures in color. In effect they take leading aircraft engines apart and lay the many parts right before your eyes for you to examine and study. Large folding charts printed in three colors show the complete lubrication system of leading engines in detail.

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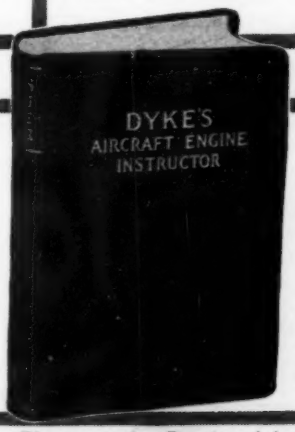

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THE FOREMOST ENGINES OF 1918

Engines	Symbol	No. of Cyls.	H.P.	R.P.M.	Weight	Lbs. H.P.	B.M.E.P.	Comp. Ratio	Type
Liberty	12-a	12	400	1700	845	2.11	119.5	5.5 -1	W. C. Vee
Hispano	41	8	180	1700	485	2.69	124.5	5.3 -1	W. C. Vee
Hispano	H	8	300	1600	596	1.98	127.8	5.3 -1	W. C. Vee
Mercedes		6	160	1250	618	3.86	105.2	4.8 -1	W. C. Vertical
Mercedes		6	260	1400	935	3.75	107.5	4.94-1	W. C. Vertical
Maybach		6	200	1200	900	4.5	107.4	4.95-1	W. C. Vertical
Benz		6	220	1400	829	3.68	113.0	4.93-1	W. C. Vertical
Rolls-Royce	Falcon	12	220	2000	723	2.68	113.0	5.3 -1	W. C. Vee
Rolls-Royce	Eagle	12	360	1800	933	2.66	127.5	5.3 -1	W. C. Vee
Fiat	A-12	6	300	1600	928	3.32	112.0	4.31-1	W. C. Vertical
Lorraine-Dietrich		8	275	1600	546	1.98	137.0	4.7 -1	W. C. Vertical
Renault		12	300	1550	836	2.78	116.0	2.66-1	W. C. Vee
A. B. C.	Wasp	7	170	1750	260	1.53	111.2	4.0 -1	A. C. Radial
A. B. C.	Dragon-Fly	9	320	1650	600	1.88	103.5	4.0 -1	A. C. Radial
LeRhone	J	9	110	1200	320	2.91	87.5	4.82-1	A. C. Rotary
Bentley	BR-2	9	200	1300	475	2.0	77.3	5.3 -1	A. C. Rotary
Salmson		9	250	1500	473	1.89	100.0	5.4 -1	W. C. Radial
Curtiss	OX-5	8	90	1400	390	4.33	111.0	4.92-1	W. C. Vee

through the air, which naturally surrounded it with the possibility of ignominious failure, and certain and cruel condemnation. Nevertheless the very boldness of the idea assured the support of all elements pledged to win the war.

Before it was produced and proved, however, its sponsors suffered merciless criticism, but it was developed into the greatest aviation engine in the world, stands as one of the signal achievements of the World War, and is still giving creditable service today.

When the Armistice was signed all the principal powers had acquired a vast amount of knowledge and experience in designing and building aircraft engines.

The principal engines available in 1918 and their characteristics are given in the chart above.

After the war, and after the smoke of cancelled war contracts, disorganization, and readjustment had somewhat cleared, the United States found three prominent builders in the aircraft engine field still carrying on, and anxious to continue the development of motors. These were the Curtiss Aeroplane and Motor Co., Packard Motor Car Co., and Wright Aeronautical Corporation.

The studies and experimental models made during the post-war intermediate period by those designers were largely confined to the water-cooled type, and, in the light of recent progress made by the same manufacturers, it appears they were simply groping about seeking an improvement on the war-time Liberty.

None of their early engines in this period represented any distinct advantage in weight, power, or reliability over the Liberty with its specific weight of two pounds per horsepower.

The chart below presents some of the characteristics of the principal engines developed between 1918 and 1923.

The last five years have witnessed the greatest advance in aero engine construction in all the history of aviation.

Intensive development of air-cooled engines has been the chief factor in this progress.

During the war, and immediately afterward, designers paid little attention to the possibilities of air-cooled engines in the United States, with the exception of Charles L. Lawrance.

Mr. Lawrance produced in 1916 a 28 horsepower, two-cylinder, air-cooled engine, used to some

ENGINES IN INTERMEDIATE STAGE OF POST WAR DEVELOPMENT

Engine	Symbol	No. of Cyl.	H.P.	R.P.M.	Weight	Lb. H.P.	B.M.E.P.	Comp. Ratio	Type
Packard	1A-1116	12	282	1600	733.2	2.59	125.1	5.56-1	W. C. Vee
Packard	1A-744	8	160	1600	541.8	3.02	119.5	5.02-1	W. C. Vee
Packard	1A-1237	12	300	1800	735.0	2.1	125.0	6.5 -1	W. C. Vee
Packard	1A-825	8	200	1800	547.0	2.34	119.0	5.02-1	W. C. Vee
Packard	1A-2025	12	550	1800	1142	2.02	132.17	5.08-1	W. C. Vee
Packard	1A-1500	12	510	2100	738	1.44	129.0	5.5 -1	W. C. Vee
Packard	1A-2500	12	800	2000	1100	1.37	....	5.5 -1	W. C. Vee
Wright	E-4	8	190	1800	480	2.5	122.0	5.35-1	W. C. Vee
Wright	H-3	12	320	1800	620	1.93	127.0	5.5 -1	W. C. Vee
Wright	T-3	12	575	1800	1160	2.0	131.5	5.3 -1	W. C. Vee
Curtiss	K-12	12	375	2250	728	1.94	....	....	.....
Curtiss	K-6	6	150	1700	417	2.78	121.8	5.63-1	W. C. Vertical
Curtiss	C-12	12	400	2250	698	1.68	131.3	5.5 -1	W. C. Vee
Curtiss	CD-12	12	400	2000	704	1.76	129.0	5.37-1	W. C. Vee
Curtiss	C-6	6	160	1750	448.5	2.79	126.9	5.2 -1	W. C. Vee
Curtiss	D-12	12	375	2000	693	1.84	133.8	5.3 -1	W. C. Vee
Curtiss	V-1400	12	500	2100	655	1.31	139.0	5.5 -1	W. C. Vee

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ENGINES OF 1928

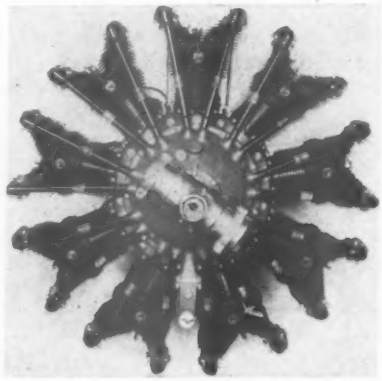
Engine	Symbol	No. Cyls	H.P.	R.P.M.	Weight	Lbs. H.P.	Comp. Ratio	Type
Curtiss	D-12 (H.C.)	12	460	2300	680	1.48	6. :1	W. C. Vee
Curtiss	V1550	12	600	2500	720	1.2	5.7 :1	W. C. Vee
Curtiss	V.G.1550	12	600	2500	840	1.4	5.7 :1	W. C. Vee
Curtiss	Hex.	12	600	2400	1000	1.62	.....	A. C. Hex
Packard	2A-1500	12	600	2500	780	1.3	5.1 :1	W. C. Vee
Packard Geared	2A-1500	12	600	2500	880	1.47	5.1 :1	W. C. Vee
Packard	2A-2500	12	800	2000	1179	1.48	5. :1	W. C. Vee
Packard Geared	2A-2500	12	800	2000	1380	1.73	5. :1	W. C. Vee
Wright	J5	9	250	2000	510	2.1	5.2 :1	A. C. Rad.
Wright	R1750	9	525	1900	750	1.45	5.4 :1	A. C. Rad.
Pratt & Whitney	Wasp	9	450	2100	670	1.49	5.25:1	A. C. Rad.
Pratt & Whitney	Hornet	9	525	1900	750	1.43	5.25:1	A. C. Rad.
Liberty	Inverted	12	430	1700	1015	2.36	5.4 :1	A. C. Vee
Liberty	Inverted	12	420	1700	900	2.14	5.4 :1	W. C. Vee

extent in "Penguin" training machines. His Model E, also produced in 1916, was a 3-cylinder radial type.

In 1920, after attempting, unsuccessfully, to interest several manufacturers in air-cooled engine construction, the Army Air Service undertook a definite program of air-cooled development in the laboratories at McCook Field. At the same time they announced a competition for the design and construction of an air-cooled radial engine for pursuit planes. The Wright Aeronautical Corporation was given a contract, as was also Mr. Lawrance, each for four engines.

Mr. Lawrance's engine, a 9-cylinder air-cooled radial of 160 h.p., was submitted in 1921 and was the first engine of that type to successfully pass the Army's 50-hour test.

The R-1, as the Lawrance engine was called, was flight tested and demonstrated its suitability for such service. Fifty of these engines enlarged in capacity, and called the Lawrance J-1, but identical in other details with the first model, were purchased the same year by the Navy for training purposes.



Front view of Pratt and Whitney Wasp, 9 cylinder, air-cooled, radial type.

The air-cooled engine research at McCook Field was prosecuted for about four years, and, when completed, made available for American manufacturers cylinder studies and designs, which are the basis for the eminently successful air-cooled engines in this country today. Only cylinders were studied. These were tested on the universal test or "rubber" engine, a base designed for testing cylinders, either air or water-cooled, with a bore range of 4 to 8 inches and a stroke range of 4½ to 9 inches. The designs tested included axial fins, circumferential fins, bolted-on heads, integrally cast heads, roof heads, flat heads, and other modifications of design, most of which proved unsatisfactory until the studies concentrated on the cylinder with cast aluminum head screwed and shrunk-on to a forged steel barrel.

It will be impossible to describe in detail the development of the Army's air-cooled cylinder, but some of the major features may be briefly described:

a. First development of high mean effective pressure air-cooled cylinders. "High mean effective pressure" in this instance refers to brake mean effective pressures in excess of 130 pounds per square inch maintained over long periods of operation.

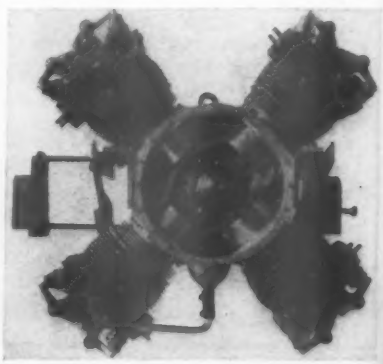
b. Development of the shrunk-in aluminum bronze valve seats. While this may appear to be unimportant no more than a glance at the troubles that have attended the use of cast-in, rolled-in and peened-in seats and remembrance of the general adoption of the shrunk-in aluminum bronze seats in cast aluminum heads is required to prove its value.

c. The development of the enclosed valve gear for air-cooled aviation engines. The advantages are complete oil bath lubrication of the valve gear with consequent elimination of wear, partial compensation for valve clearance, retention of push rods when a valve spring fails, and protection of valve gear from the effects of exposure (particularly desirable in

(*Continued on page* 107)

Front view of Wright, J-5 Whirlwind, 9 cylinder, air-cooled, radial type.

Rear view of Fairchild Caminez motor, with cover removed to show the cams. This is a 4 cylinder, air-cooled, radial type.



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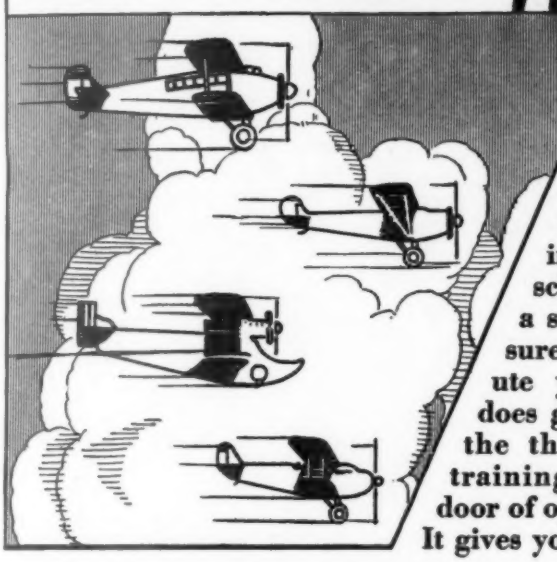

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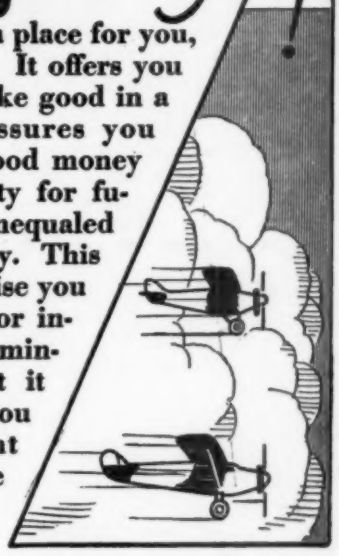

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A book well qualified to serve as a gift to anybody with the desire to know "how it feels to fly" is a training manual just published by the Ronald Press. This is

Practical Flying: A Training Manual for Airplane Pilots, by Byron Q. Jones, Major, Air Corps, U. S. Army. The Ronald Press Co., New York: 1928, 210 pp. Illustrated with 6 plates.

Major Jones' Practical Flying has a right to its name. It is an attempt to save the time of students and instructors alike by providing a clear, systematic text-book for use on the flying field. Through long experience in helping develop the Army Air Corps' methods of pilot instruction, Major Jones has become familiar to an unusual degree with the problems of flying schools and their pupils. He has incorporated in this book a good deal in the way of information, explanation, and counsel which is of importance to the student pilot but which is sometimes omitted from the primary flying course because of lack of time and opportunity.

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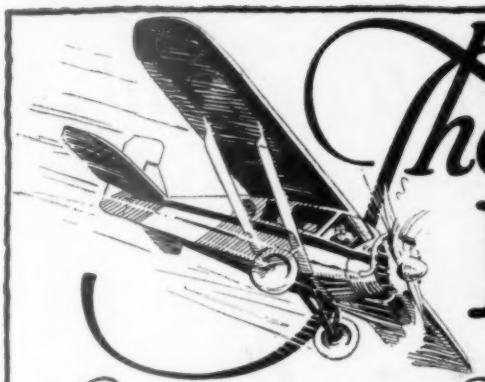

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Sailplane Construction

Fig. 1. The simplest connection between supporting wings and control works consists of four steel tubes assembled into triangular combination, as shown here.

By Alfried Gymnich

Translated by John H. D. Blanke

(Continued from the November issue, Installment IV.)

THE fuselage forms the mediatory link between the supporting wings and the control works; it serves to carry the flyer, and the control organs, and to connect the supporting wings with the controls in a suitable manner. Therefore, in the case of hanging gliders and schooling or training sailplanes, the fuselage consists as a rule only of a few stays connected in triangular design for naturally such a framework can be designed, technically, without difficulties, can be more easily and more cheaply constructed than a completely enclosed fuselage and, moreover, the damages which can never be avoided in training service, are more easily repairable. But such a fuselage framework creates a great additional resistance, which is still further increased by the fact that the body of the flyer is also exposed to the open air. Where high performance is desired in the sailplane a good ascending value, and a high flying speed, are essential, and the design must aim, therefore, towards a low air resistance by constructing a completely enclosed stream-line shaped fuselage, to take up the pilot, the transmitting equipment for the controls, etc. In the case of the schooling sailplanes this factor is dropped, since these are intended merely for flying in slope winds and not for the establishment of records. Moreover, for a purely aviatorial training it is, of course, immaterial whether the flight continues over a shorter or a longer period, for the main thing is merely to acquaint the operator with the control organs and to aid him in acquiring skill in their manipulation.

One of the simplest connections between the supporting wings and the control works is represented by the wing-controlled monoplane Muenchen shown in Fig. 1. Here the entire fuselage framework consists merely of four carriers or beams of steel tubing, which are tied together in triangular design. Another very simple construction is indicated by the fuselage framework of the schooling glider shown in Fig. 2; however, the stay located ahead of the head of the flyer should be avoided if at all possible, as is the case with the schooling plane of the Rhoen-Rositten-Gesellschaft, the fuselage framework of which is shown in Fig. 3. Such a fuselage framework can be considered as standard for simple schooling sailplanes as well in respect to simplicity as in respect to strength. However, if one intends to build a real fuselage, it is better not to leave it uncovered. The slight additional cost for the covering and the perhaps somewhat greater weight are abundantly compensated for by better flying qualities.

The closed fuselage may be designed in three different ways. First, a special wood framework, that is,

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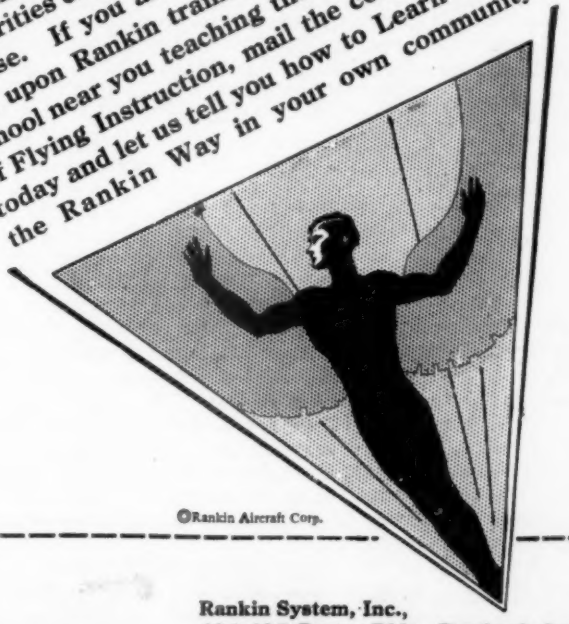

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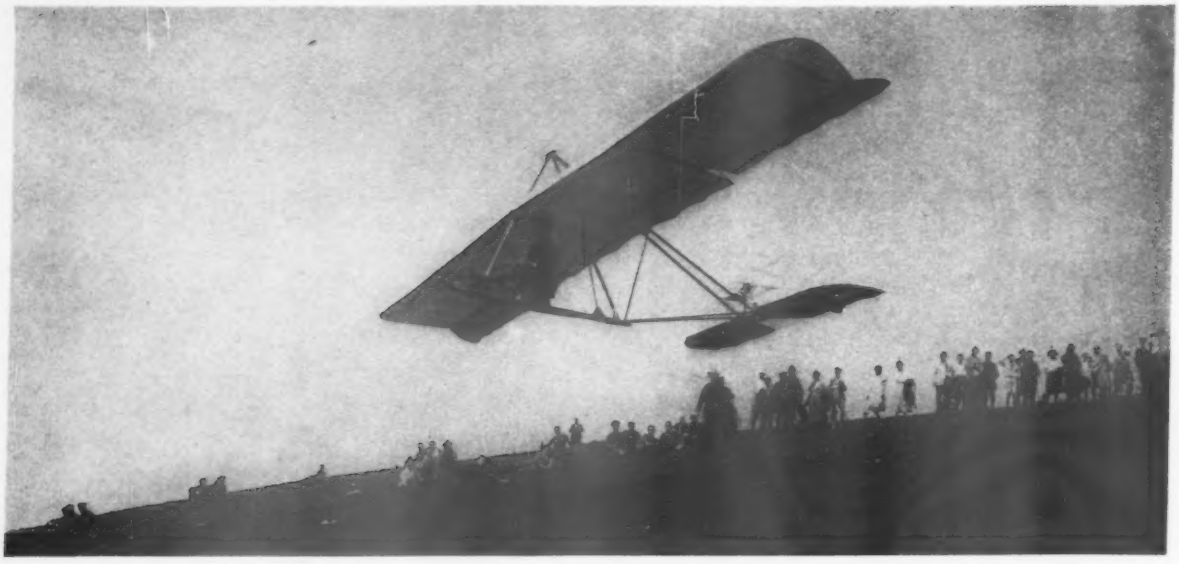


Fig. 2. Training glider with fuselage framework easy to build. It is well to avoid the stay in front of the pilot's head, for it may cause injury.

longitudinal beams which are interconnected with stays and combined into a rigid frame by the use of diagonal stays or diagonal braces, may be used (Fig. 4); second, welded or riveted steel or Duralumin tubing may be employed; and third, longitudinal beams or supports and a number of cross walls called frames, glued together at certain distances, may prove satisfactory for some cases. A fuselage constructed according to the last method is laid over with plywood, in contrast to the first two

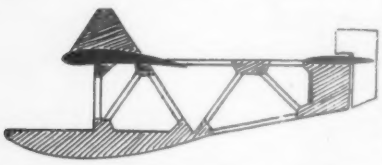
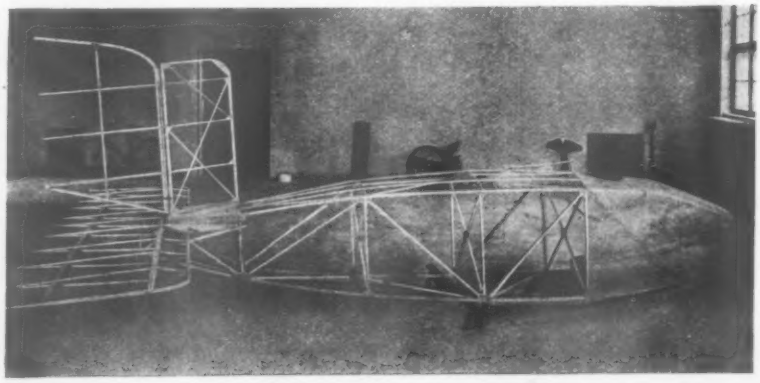


Fig. 3. Fuselage frame of the monoplane of the Rhoen-Rositten-Gesellschaft. There is no stay in front of the flyer. The shaded portions are covered with plywood.

designs which are nearly always covered with fabric. Since the covering of plywood also serves in transmitting or taking up the forces, diagonal stays are more or less superfluous and the entire fuselage frame can be held together more easily than one covered with fabric. The assembly of such a fuselage of cross frames is started upon a form, similar to the form used in constructing a ship.

The shape of the fuselage in cross section may be round, oval or angular. In the construction of sailplanes one finds most frequently the square or rectangular fuselage, since this one offers fewer difficulties than do round or oval fuselages, from the standpoint of design and construction. The shape of the cross frames determines the shape of the fuselage. The longitudinal beams consist as a rule of spruce; in rare cases ash wood is used for beams which are to be bent considerably. Although this wood is of course stronger and more elastic, it is difficult to work and it has a considerably higher specific weight. The cross frames are exclusively made of spruce and in order to attain a greater strength they are blocked with thin plywood transversal to the direction of the grain. The cross frames in the front, especially those which must carry the fittings for attaching the supporting wings, are more strongly designed, whereas those in the rear which render less exacting service, are designed as so-called construction cross frames of weak ledges with corners of plywood. The various illustrations show the more customary designs of cross frames. Naturally more cross frames are required for round and oval fuselage than for anugular fuselages, in order to preserve the shape. Therefore, one or two auxiliary cross frames are as a rule set between two supporting cross frames, which are designed especially to avoid unnecessary weight, and which serve merely to maintain the shape. The number of longitudinal carriers or fuselage beams for connecting the cross frames depends also upon the shape of the fuselage. In general, here also four longitudinal carriers are used, and, as required, weaker ledges

Fig. 4. A fuselage built without cross frames. The construction of the control works is also clearly shown.



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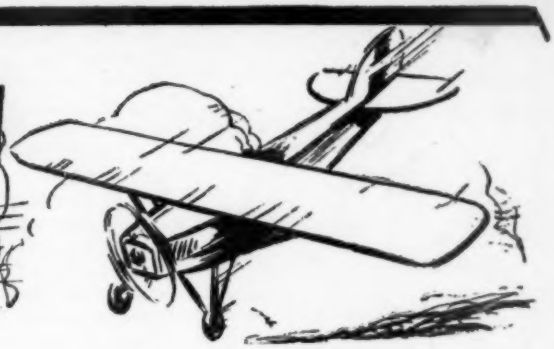

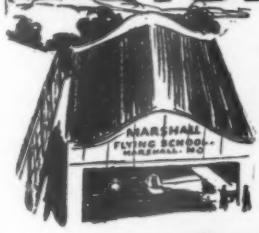

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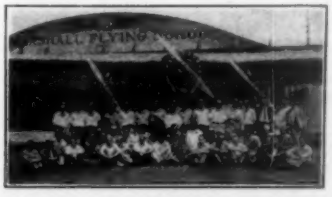

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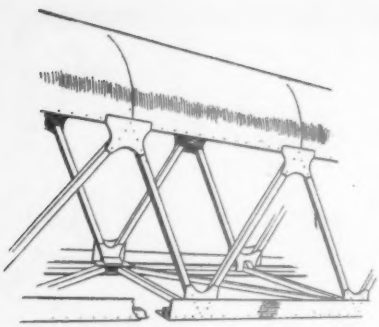


Fig. 5. A fuselage constructed in triangular combination, the joints of which are lapped over with plywood. The arched roof of the fuselage is already planked with plywood.

for maintaining the shape of the fuselage are built in.

The framework of a fuselage covered with fabric must be resistive to torsion, and this may be effected, as already mentioned, by placing piano wire diagonally in all square fields or using diagonal stays. The latter method is frequently used since it can be carried out more easily inasmuch as complicated fittings for attaching the reenforcing wires are avoided. Such auxiliary means are not required for fuselages of plywood; in this case the torsional strength is attained by the covering of plywood.

Thus far metal fuselages have not been used very widely in sailplanes. Even though metal permits far quicker and more accurate calculation than wood, which is always subject to heavy fluctuations in strength, the latter is preferred in the construction of fuselages, for fuselages of wood are easier to construct and can be repaired without special tools and machines.

Those parts of airplanes which serve for stabilizing and changing the direction of flight, are designated as control works or guiding works. One differentiates between vertical and horizontal control works. The control works consist of fins and rudders. The immovable, rigid parts of the controls, which give to the airplane a certain stability in direction, are designated as fins, whereas the movable parts, which serve to correct deviations from equilibrium which make possible desired changes in direction, are designated as rudders. Vertical fins and rudders control movements of the plane to left or right about the vertical axis; horizontal fins and rudders control movement up and down about the horizontal axis. To the control works belong furthermore the transversal rudders joined to the ends of the supporting wings, which serve for maintaining the transversal stability.

Concerning the manner of working the rudders we have already written in the second installment, so that another discussion of this topic is unnecessary. In order to decrease the controlling work to be done by the pilot, the rudders of airplanes are frequently compensated or unloaded; that is, they have small surface portions located ahead of the rotatory axis, whereby a portion of the air force coming into effect when manipulating the rudders, is compensated. But such compensated or unloaded rudders are hardly necessary in the construction of sailplanes, for the rudder forces which occur here are slight. Furthermore, too much compensation of the rudders is detrimental, since a certain control pressure is then necessary for controlling by the sense of feeling.

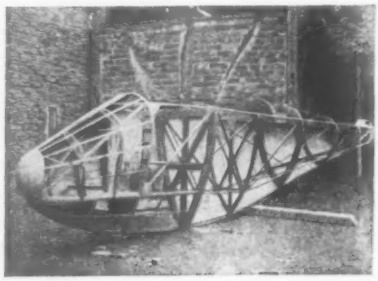


Fig. 6. An oval-shaped fuselage with cross frames. Observe the massive main cross frame and the light auxiliary cross frames, and also the weak ledges in front which serve only to maintain the shape.

The construction of the control works is similar to the construction of the supporting wings. Here also beams and ribs are used, with this difference only, that the cross section of the control works indicates instead of a profile shape, a stream-line shape. A special discussion of the assembly is therefore unnecessary, especially since this subject is covered in the illustrations.

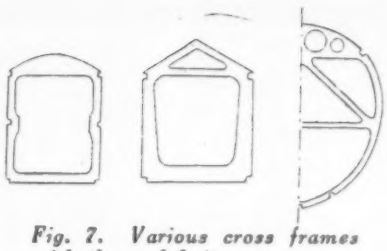


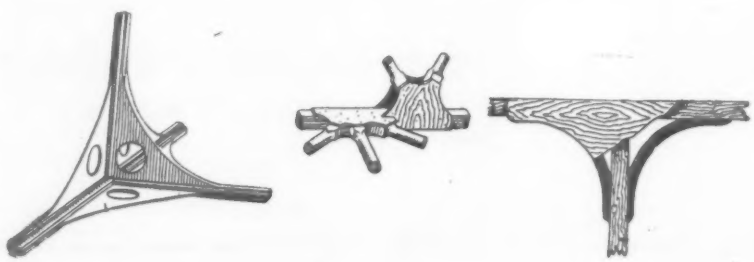
Fig. 7. Various cross frames with plywood fitting.

The connection between the rudder and the control stick is effected either by cables which are led over rollers of large diameter or by push rods in connection with angle levers. The latter method is coming more and more into use; as it offers greater advantages in assembly and taking down, and the friction is as a rule less. The side control is always, without exception, connected to the pedals by means of cables.

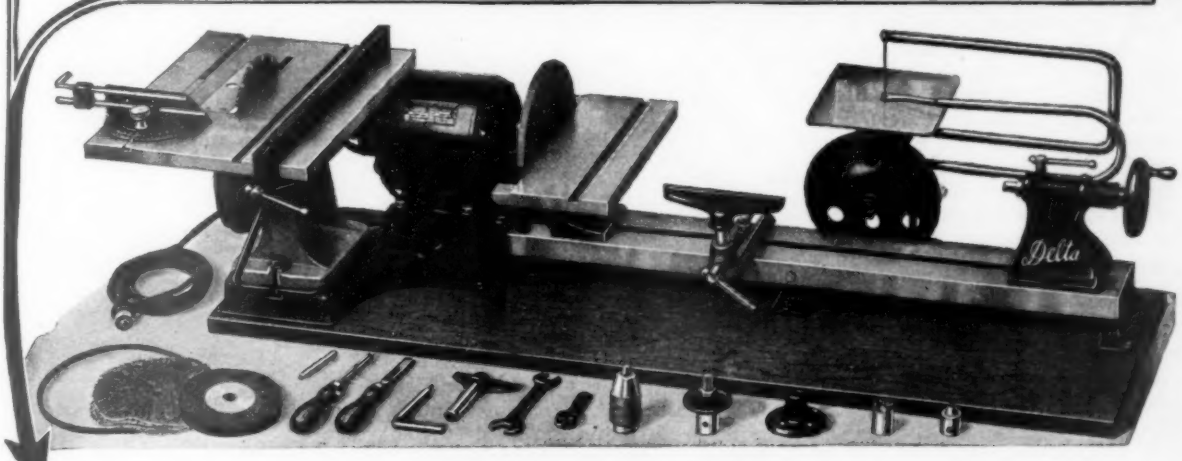
(To be continued)

Interest in gliding and the construction of gliders is becoming more and more widespread, if the number of letters which come to the offices of Popular Aviation from gliding enthusiasts can be regarded as evidence. A good many correspondents want detailed information concerning particular problems. In an attempt to meet these special needs, we have ordered a selection of blueprints and working drawings from Germany, and as soon as these arrive we will be glad to supply copies at cost. Do not order any of this material until we have announced its receipt.

Fig. 8. Construction of Fuselage Joints.
Left: An unusual method with the use of grooved ledges and angles of plywood.
Center: Simple overlapping with plywood.
Right: Connection of beam and cross frame by means of several thin glued laths, and overlapping of plywood.



20 *New Big Exclusive Features in the* 1929 Model "Delta" Electric Handi-Shop



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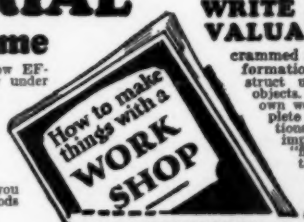

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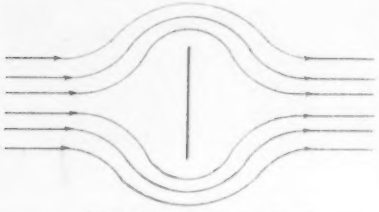
Simple Aerodynamics

By Alexander Klemin
Daniel Guggenheim School of Aeronautics, New York University.

Streamline Flow, Bernouilli's Law, Perfect Fluid and Streamline Flow

A PERFECT fluid is one in which there is no loss due to friction. Of course no fluid like air or water is frictionless. Streamline flow may be defined as flow in which all changes of direction are gradual, and in which no eddies or whirls are formed. Streamline bodies may be defined as bodies whose section changes gradually and round which the flow is without eddies or whirls.

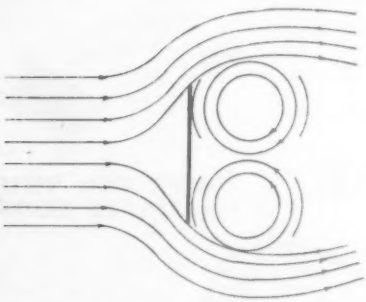


FLOW AROUND A FLAT PLATE IN A PERFECT FLUID

FIG 1

In a perfect fluid all bodies would be streamline. For example the flow round a flat plate like that shown in Figure 1, would be streamline, and perfectly symmetrical in front of and behind the plate. As a matter of fact the actual flow round a flat plate is like that shown in Figure 2, with large eddies behind the plate.

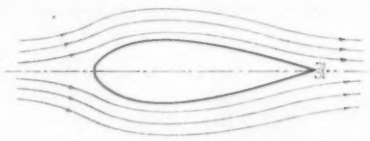
Even a fish-like or streamline body like that shown in Figure 3, disturbs



ACTUAL FLOW AROUND A FLAT PLATE

FIG 2

the flow slightly, not at the bow or front end but at the tail, where small eddies cannot be avoided. For a very well streamlined body, these eddies are so small, however, that the flow is very like that which we would find in a perfect, frictionless fluid.



FLOW AROUND AROUND A FISH-LIKE OR STREAMLINE BODY

FIG 3

Therefore, while a perfect fluid does not exist in nature, we can assume a perfect fluid in theorising about streamline bodies, and the conception of a perfect fluid is very useful to the aeronautical engineer.

Of course in practical airplane design, the idea of a perfect fluid is disregarded, and the engineer tries to make all objects exposed to the wind as streamlined as possible.

Bernouilli's Law

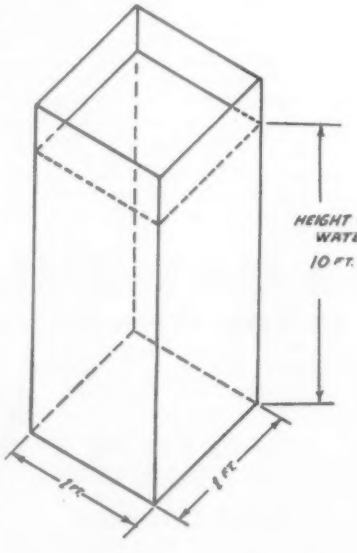
It is surprising how many famous Italian names appear in aeronautics.

Thus Leonardo da Vinci, the versatile and immortal genius of the fifteenth century made the first scientific observations on the theory of flight.

Another Italian discovered the Venturi tube, so frequently used in the measurement of air and water flow.

Bellanca's monoplane designs need no introduction to our readers.

Still another Italian, Bernouilli, enunciated the famous law, known by his name, which connects pressure and velocity for a fluid in motion.



WHAT IS PRESSURE ON BOTTOM OF TANK?

FIG 4

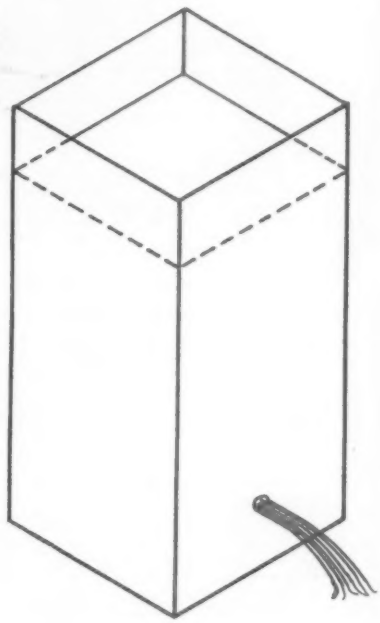


FIG 5

This law states that if a fluid is perfect or frictionless, then the energy of a part of the fluid along a streamline always remains the same.

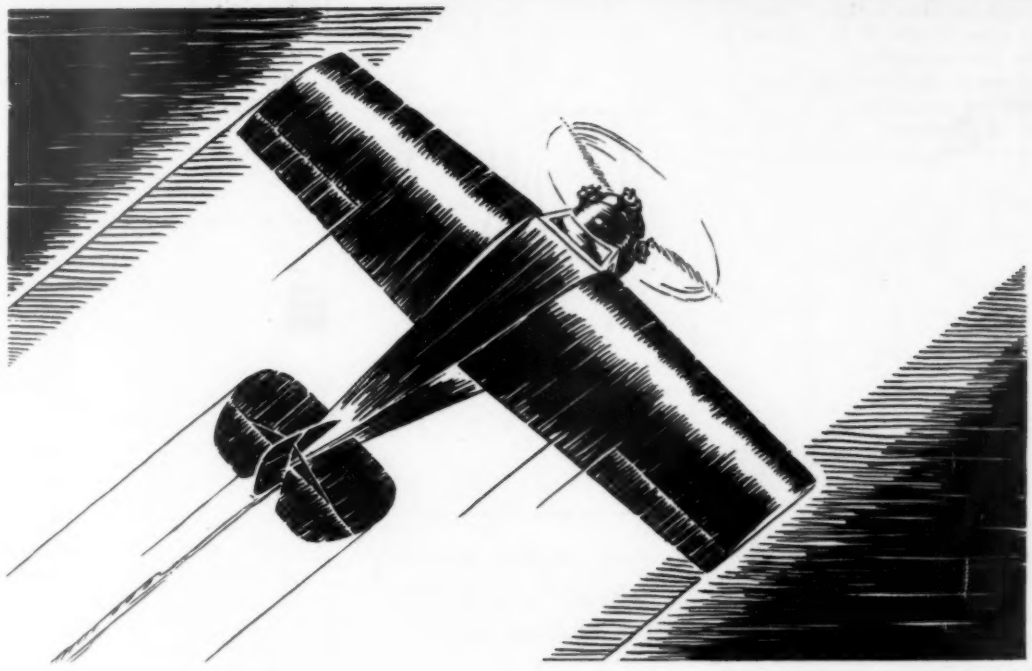
This law is true, to a very close approximation for such flow as we encounter in aerodynamics.

The energy of a fluid may be divided into three parts:

1. That due to position or height, which is termed potential energy.
2. The pressure energy.
3. The energy due to motion or kinetic energy.

It is most important to be able to express these components of energy all in the same way.

It is easier to do this by first think-



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ing of water (which has a density of 62.5 pounds per cubic foot).

Suppose we have a tank, 1 square foot in area, as shown in Figure 4, open to the atmosphere, with a column of water 10 feet high, what is the pressure per square foot at the bottom of the tank? The pressure per square foot at the bottom of the

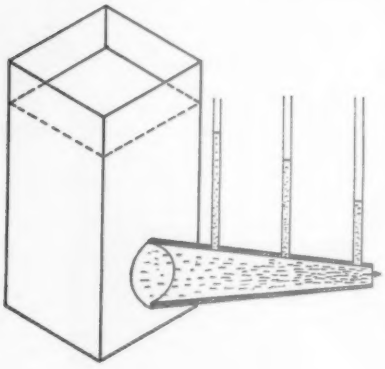


FIG 6

tank will be that due to the atmospheric pressure plus the pressure of the weight of water, that is 2117+ 10×62.5=2742 pounds.

In other words to convert head of water in feet into pressure per square foot in pounds, we must multiply the density by the head.

If as in Figure 5, the tank is opened through an orifice, to the air, the water will come out of the tank with a certain velocity v (in feet per second) and its kinetic energy per pound will be $\frac{v^2}{2g}$ (see Article 1).

Now this kinetic energy is due to the drop h. Therefore $\frac{v^2}{2g} = h$.

And since the pressure due to the head h is w × h, the pressure equivalent of the kinetic energy is also $\frac{w\ v^2}{2g}$.

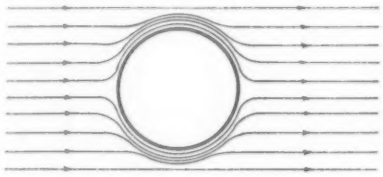
So that if we call the pressure in pounds per square foot "p," the total energy will be:

$$p + \frac{w\ v^2}{2g} + wh.$$

According to Bernouilli, this must remain a constant and so along a streamline.

$$p + \frac{w\ v^2}{2g} + wh = C$$ where C is a constant.

Suppose instead of opening into an orifice the tank opened into a pipe,

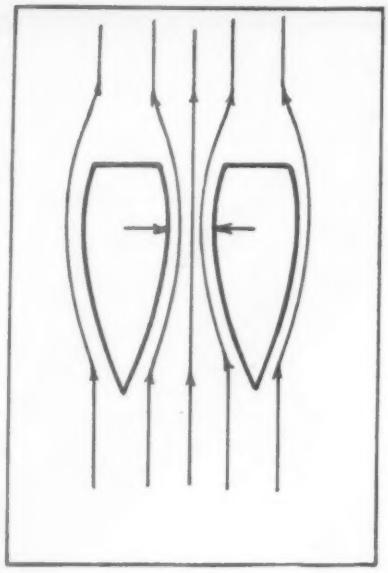


FLOW AROUND A STATIONARY CYLINDER

FIG 9

as in Figure 6, of varying cross-section, and we had tubes opening to the atmosphere, placed along this pipe.

At narrow sections of the pipe, the velocity and kinetic energy of the water are large, and the water rises but a little height in the tube. Where the pipe is large in cross-section, the velocity and the kinetic energy are small, and the water rises almost to the same level as in the tank.

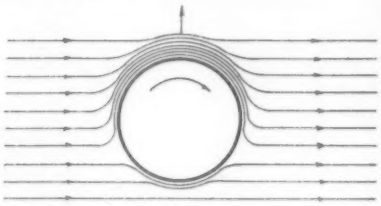


TWO BOATS MOORED CLOSE TOGETHER IN A STREAM DRAW TOGETHER

FIG. 8

In aerodynamics we are not concerned with position head or potential energy, because we are primarily interested in flow, at one level, so that Bernouilli's equation becomes simply

$$p + \frac{w\ v^2}{2g} = C,$$ with w the weight of one cubic foot of air.



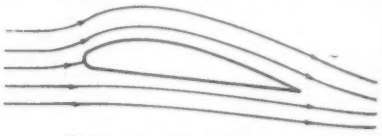
FLOW AROUND A ROTATING CYLINDER

FIG 10

We can say, in other words, that in aerodynamics the pressure, plus the pressure equivalent of the velocity remain constant. Where the pressure is high, the velocity is low and vice versa.

Some Curiosities Explained by Bernouilli

Suppose that a man blows between two sheets of paper (cigarette paper by preference), as shown

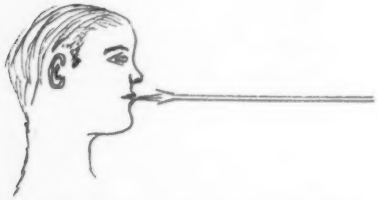


FLOW AROUND A WING

FIG 11

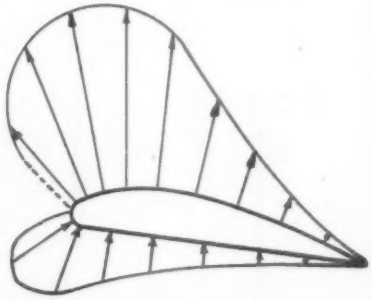
in Figure 7. They will not blow apart, but stick the more closely, the harder he blows. That is because the moving air loses pressure in accordance with Bernouilli.

Two boats moored close to one another in a stream as shown in Fig. 8, are drawn together. Why is that? Because the water flow between them is more rapid than the flow on their outer sides. Therefore the pressure



MAN BLOWING - TRYING TO SEPARATE TWO SHEETS OF PAPER

FIG 7



PRESSURE DISTRIBUTION AROUND A WING

on their inner sides is less than the pressure on their outer sides.

The action of Flettner's famous rotor ship is explainable by Bernouilli. Fig. 9 shows the flow round a stationary cylinder (neglecting friction effects). When the cylinder is rotated as shown in Fig. 10, it will crowd the streamline above the cylinder, and the velocity will be greater above than below the cylinder. Hence by Bernouilli, the pressure below will be greater than the pressure above, and the cylinder will experience an upward force as shown in our diagram.

Bernouilli's principle will also explain how a pitcher throws an "up" curve. The flight of a golf ball may also be studied in the same manner.

Many Applications of Bernouilli in Aerodynamics

The reader may question the value of the preceding paragraphs. They were intended to give him a fundamental understanding of the great law, which we will now apply to same aerodynamical problems:

The Air in Flying May Be Considered Incompressible

An airship is moving through the air at 100 feet per second in air having a pressure of 2117 pounds per square foot. What is the excess in pressure at the center of the bow of the airship? At this point the relative air velocity is reduced to zero. All the relative kinetic energy is converted into pressure. The equivalent of the kinetic energy pressure is:

$$\frac{w\ v^2}{2g} \text{ or } \frac{.0764 \times 100^2}{2 \times 32.18} = 11.9 \text{ pounds}$$

per square foot.

This is not very much as a percentage of the undisturbed air pressure of 2117 pounds. The air as we encounter it in aviation may be considered as incompressible. It is only at the tips of fast moving propeller blades, or when we attain velocities of 500 miles per hour, that the compressibility of the air will begin to bother us.

Explaining the Lift of the Wing

If the man in the street is asked what the lift of the airplane's wing is due to, he is likely to say that it is due to the pressure of the air on the under surface of the wing. But if as in Fig. 11 we draw the lines of flow around a wing, we see that the air underneath experiences scarcely any change in velocity. The air above the wing has to undergo an increase in velocity, because it is going around a curve. Therefore, again from Bernouilli's law there will be a decrease in the pressure above the wing; or a suction if we like to call it so. It is this suction which is mainly responsible for the lift on the wing. There may be some excess pressure underneath, but this will not be nearly as great as the suction above. Fig. 12 shows a typical distribution of the pressure around a wing. We shall later have to discuss pressure distributions for a wing in greater detail.

POPULAR AVIATION wishes to apologize to its readers for two mistakes which occurred in the first article on Simple Aerodynamics. In Figure 12 the center of lift is shown in front of the center of gravity. It should, of course, be shown 1.5 feet behind the center of gravity, in accordance with the text. In column three a second correction needs to be made. A man raising 100 lbs. 5 feet does 500 foot pounds of work.

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Financial Survey of Aeronautics

By R. D. Small

General Manager of Aviation Financing and Trading

CHICAGO and the midwest on Wednesday, October 31st, took a decisive step forward as a financing center for aviation, with the launching of two large aeronautical enterprises, one, the Universal Aviation Corporation, and the other, the Great Lakes Aircraft Corporation.

The former has an authorized capital of 500,000 shares of common (no par), of which there are outstanding 321,564 shares. Stock was issued at an initial price of $17.50.

The consolidation includes several groups. First is the Robertson Aircraft Corporation of St. Louis, which has been carrying passengers and United States mail from Chicago to St. Louis, and St. Louis to Omaha via Kansas City at very satisfactory profits. Extensions from St. Louis to Dallas and from Dallas via Little Rock to some point in Ohio, either Columbus or Cincinnati, are contemplated. The Robertson Aircraft Corporation owns three hangars and equipment, including tri-motored planes and smaller craft. Second is the Universal Airlines, Inc., which operates a transport system on daily schedules between Cleveland, Chicago, and the twin cities, affording a link in an air rail system between the twin cities and New York, conducted in co-operation with the New York Central Railroad.

Third is the Universal Airlines Terminal, which has a passenger terminal at Cicero field at Chicago, and two modern hangars completely equipped. Fourth is the Northern Aeronautics, Inc., which operates airplane lines on schedule, running from Minneapolis and Duluth, and to Fargo, in addition to conducting a flying school. Fifth is the Universal Holding Corporation, which, through subsidiaries, operates the Egyptian Airways of St. Louis and conducts a flying school at Marion, Illinois. A sixth element is constituted by part of the company's revenue, produced through its sale of stock, was applied to the purchase of 50,000 shares of Fokker Aircraft Corporation.

The company's operations cover a very extensive section of the midwest and the firm is already on an earning basis.

The directorate exhibits financial strength and operating ability: John A. Hamilton, of the banking house of Hamilton & Company; Anthony H. G. Fokker, president of Fokker Aircraft; Frank Robertson, president of the Robertson Aircraft Corporation; Arnold G. Stifel of the stock and bond house of Stifel, Nicolaus & Company, St. Louis; J. G. Williams, vice-president of the Mississippi Valley Trust Company, St. Louis; A. H. Rand, capitalist, Minneapolis; H. C. Piper of Lane, Piper & Jaffray; L. H. Piper of Piper Brothers, Inc.; Thos. G. Cassidy of McGowan, Cassidy & White, Chicago; Frank D. Chase, Chicago; P. G. Kemp, vice-president of Universal Airlines, Chicago; A. F. Pillsbury, Pillsbury Flour Mills, Minneapolis; Frank Phillips, president of Phillips Petroleum, etc. We are advised at this writing that Universal Aviation Corporation will be listed on the New York curb.

Great Lakes Aircraft Corporation is listed on the Chicago Stock Exchange.

Financial structure: Class "A" (no par value), authorized 500,000 shares, 200,000 outstanding. Class "B" stock (no par value), authorized 300,000 shares, 300,000 outstanding. Two shares of the "A" are convertible at any time into one of Class "B." Class "A" is preferred over "B" as to dividends of $1.50 per share per annum payable quarterly, February, May, August and November.

The company has acquired the physical property at Cleveland, Ohio, of the Glenn L. Martin Company, which has built a large number of planes for United States naval and military purposes. In the deal is included land owned in fee, together with the factory thereon and its equipment.

The present plant in full operation employs around 1,100 men, and the manufacturing practice is modeled after straight line production.

With Glenn Martin on the board of directors and the operations of the company's affairs directed by William R. Wilson, chairman of the board, and who was formerly president of the Murray Body Company, the company should enjoy a very capable and efficient management.

Class "A" stock was offered at 24½ and closed in the first day's trading on the exchange at 26. The underwriting group consisted of A. B. Leach & Company, Harry C. Watts & Company, and Paul H. Davis & Company, all of Chicago.

Chicago, Detroit, St. Louis, Wichita, St. Paul and Minneapolis, and Cleveland have in the last 3 months originated aeronautical consolidations to a very significant extent. The midwest continues its increasing importance as a center for aviation financing.

One company whose stock is always classed with the aeronautical accessory securities, Claude Neon Lights, Incorporated, has exhibited a growth of business that is almost unbelievable and the company's stock has also given a remarkable performance.

The company started a few years ago with about $50,000 capital. The volume of business today of this company and its subsidiaries is reported at an excess of $18,000,000, with the rate of increase each month between $150,000 and $200,000. When the U. S. Supreme Court refused, a short while ago, to rehear a suit which had validated Claude Neon Lights patents it put the company in a position of operating a practical monopoly in the new illuminating sign field. The decision protects this company in the use of "a system of illuminating by luminescent tubes," and "a method of separating Neon from gases with which it is mixed," as set forth in patents 1,125,476, and 1,191,495.

The company owns the Georges

(*Continued on page* 118)

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Name.....

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Remarks and questions.....

The Atlantic City Model Contest

THE excitement of the contest and the smoke of the battle has almost cleared. Another national contest has been brilliantly staged by the Playground and Recreational Association of America at their gala two-day model airplane contest at Atlantic City, October 5th and 6th.

Strong teams were present from the following cities. The 46 boys from these 17 cities won points as indicated:

Washington, D. C.	79
Topeka, Kan.	34
Knoxville, Tenn.	32
Evanston, Ill.	29
Chicago, Ill.	26
Elmira, N. Y.	24
Boston, Mass.	23
Peru, Ind.	23
Baltimore, Md.	9
Pittsburgh, Pa.	7
Montclair, N. J.	6
Oak Park, Ill.	5
Buffalo, N. Y.	4
Newport News, Va.	0
Providence, R. I.	0
Reading, Pa.	0
San Diego, Cal.	0

Bad weather prevented records being broken in the outdoor events on Friday the 5th. However, some interesting models were flown in spite of the high winds which crashed many of the machines. There was an assortment of rocket driven models from Boston and Washington. These performed spectacularly. Some burned on the "puff off," while others sailed in pretty loops, sticking noses in the ground for a final grand colorful rocket burst of pyrotechnics from the "puff-peller." Two compressed air models showed up. They were very light machines which made excellent flights in the trials, and demonstrated their power and flying ability in taking first and second places over the rocket planes against the choppy winds. The builders of these machines stated that much better results would have been obtained if more than 48 inch wing span could have been used. Better weather conditions and larger wing spans should see this type of model performing wonders in future contests.

Launching a hydro model from the contest pool at Bader field.

The spring models were failures in performance against the wind. They were flopped to the ground as soon as launched.

One twin pusher which penetrated the choppy wind curtain during a brief lull, made a trial flight of five or six minutes and was lost in the bay almost a mile away, making the best flight of the day. Its time was unofficial, however.

A humorous condition existed at the right starting circle when a judge with all good intentions would flag the start of a model to the relay flagman by repeatedly crashing his flag violently across the path where the model might easily swerve. Fortunately, he missed all of the models, but some only by inches!

The evening events at the end of the Big Pier were very interesting. Chief Judge Hon. Edw. P. Warner, As-

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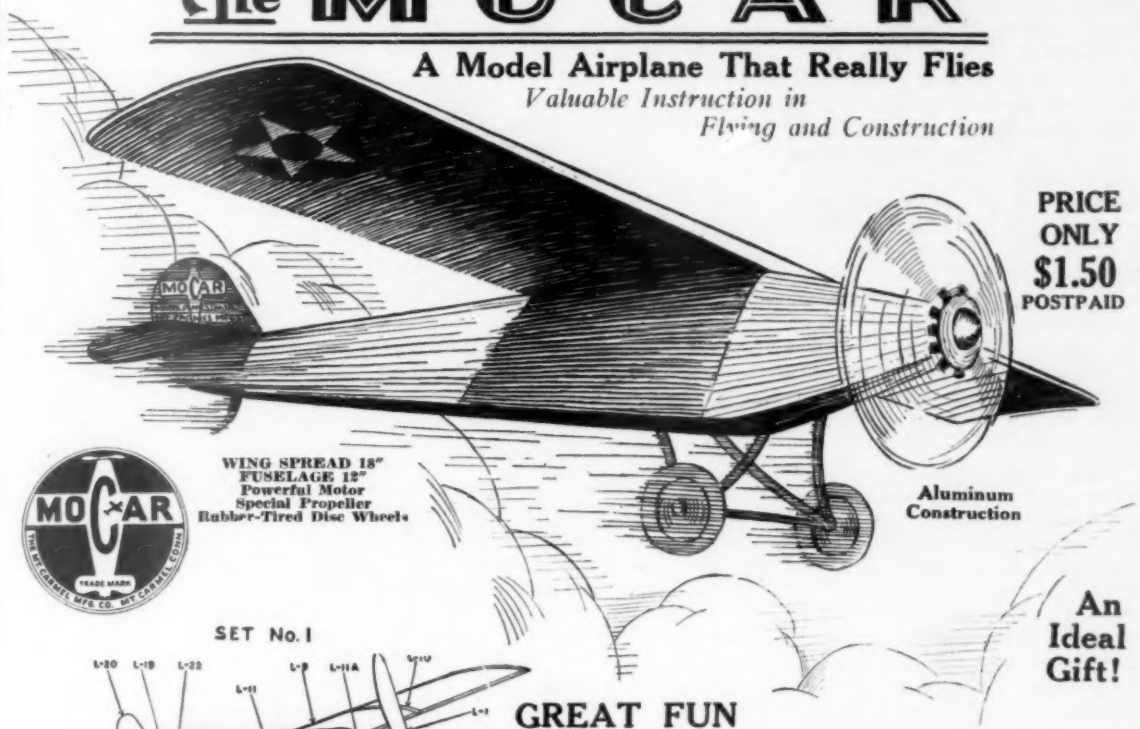

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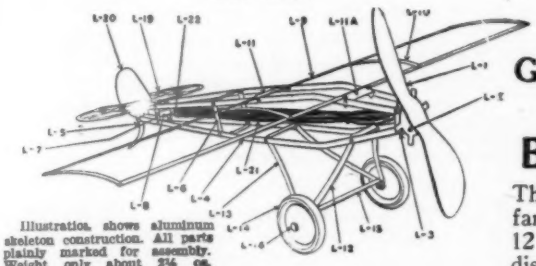

Illustration shows aluminum skeleton construction. All parts plainly marked for assembly. Weight only about 2½ oz. Note the practical design and sturdy method of building.

Illustration shows set mounted complete ready for assembly. Cut above shows all metal skeleton ready for covering, and the large illustration, actual cut of finished plane.

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P. O.....

assistant Secretary of the Navy, in charge of Aeronautics, was in attendance and gave an experienced helping hand to the smooth running of the contest.

The glider event netted a new record. (See separate article.)

The indoor hydro event was closely contested and remarkable flights were obtained in spite of the small size of the tank and the high edge to jump at the end. Robert Atwater of Elmira set the junior record for this event.

The contestants played tag running between the hydro judges and the "commercial" and weight carrying judges, trying to get their flights in the books in time. It was quite late when the evening events were all completed.

Many models patterned after the Popular Aviation Commercial Transport were in evidence. Several places were won by these models. Ernest Marcouiller had a pretty Transport model which won a Popular Aviation medal for him and helped him to win one of the handsome trophy cups. (Notice his smile in the picture.)

The indoor duration was a test of propeller tips. The low ceiling and side decorations kept the "sky hook" models clicking the roof for an outlet for their potential duration. Last year's record of 2 minutes and 9 seconds was raised to 2 minutes and 25 seconds in spite of the low ceiling. Flights better than 3 minutes, at least, would have been obtained if the Municipal Auditorium had been completed as originally planned.

The weight carrying figure was raised from .454 to .689 for 30-inch fuselage models. Mr. Paul Garber of the Smithsonian Institute officiated effectively at the weighing-in scales.

After a good night's rest, the contestants found the weather more favorable at Bader Airport Saturday morning.

The I. M. A. C. boys flew their fuselage models the full length of the large flying field. Myers' machine landed in the river and was rescued after a patient wait for the slow current to carry it close to shore. A time of 2 minutes and 56 seconds was established for this event.

The speed events were full of speedy models, but only the ordinary duration machines were able to cross the line. The course, 300 feet, seemed a trifle long for real speedy ships. Only 12¾ miles per hour was made by these ships. The best speed jobs made perhaps 40 to 60 miles per hour, but covered only 250 to 275 feet at most.

The real feature of the day was the breaking of the hydro record by Tudor Morris of Peru, Indiana. He used an old, simple principle—but if you want details of this model, mail your note to the model editor right away so that the drawings and data can be prepared.

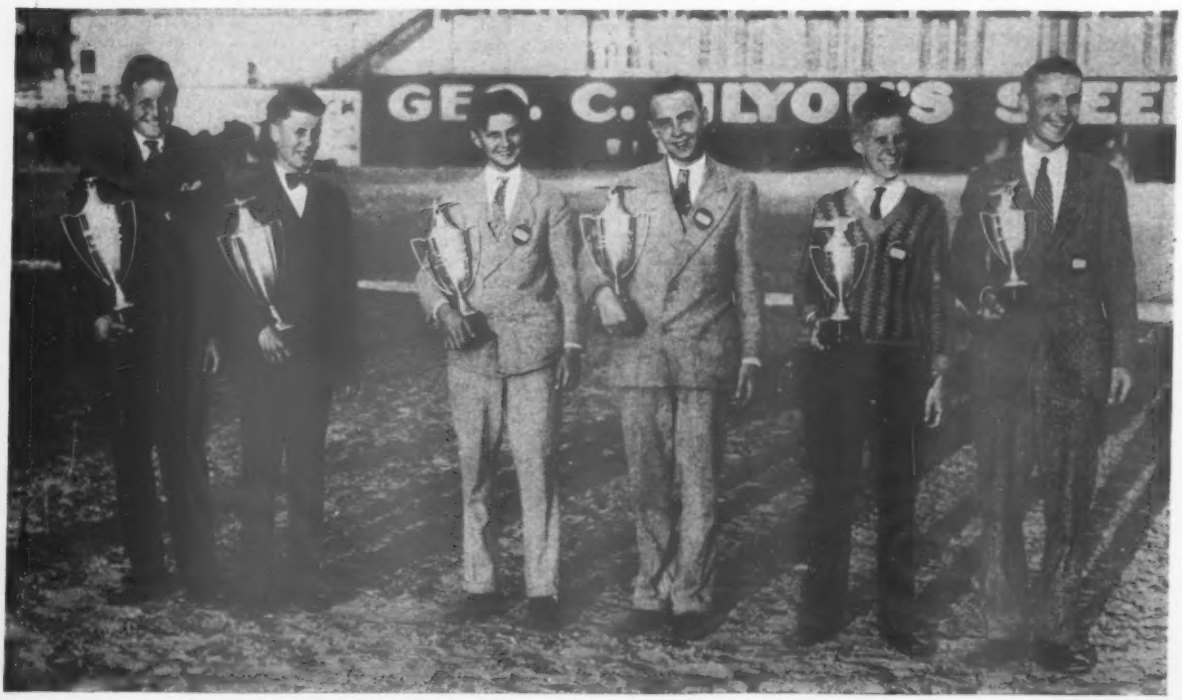
Last year's hydro winner, Virgil Rassner, suffered the misfortune of having his fine model accidentally knocked down and crushed by a policeman after a very successful take-off for what might have been a record hop.

Launchings were from a pool on Bader Field, prepared by the local committee and the Atlantic City Fire Department, who pumped the pool full of water through a long hose line.

Mr. "Tom" Rivers was right on the job and kept things moving and organized. He had an effective corps of assistants. The local committee did excellent work in caring for the numerous local arrangements effectively.

The Playground and Recreational Association of America model contests have the hearty support of Popular Aviation. Miss Sybil Baker of Washington, D. C., best expressed this thought perhaps when she said that words could hardly express the value of this model activity to the boys of the United States, and the Association should continue its good work.

Winners of Popular Aviation trophy cups, from left to right: 1st place—Herbert Dorcey, Washington, D. C.; Edwin O'Donovan, Topeka, Kans. 2nd place—Ernest Marcouiller, Evanston, Ill.; Robt. Atwater, Elmira, N. Y. 3rd place—Geo. T. Bell, Washington, D. C.; Lloyd Fish, Washington, D. C.



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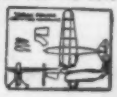

Indoor Glider Record Broken

True to form, the Illinois Model Airplane Club members came to the front by breaking the indoor glider record in the contest at Atlantic City. Mr. D. Lockwood of the Illinois Club fairly walked away with the glider contest with his fine glider model which seemed to sail along through the air as though it had "sky hooks," (borrowing Mr. Garber's favorite expression), making in his best trial the record time of 14.6 seconds.

Mr. Lockwood builds some wonderful models, and his performance in the outdoor commercial contest is worthy of note. The pretty fuselage model had many novel features, such as special body construction, motor attachment, chassis, etc. Lockwood's "Commercial" and that of Myers, his teammate, were the outstanding "commercial" ships in the outdoor contest.

A New World's Record for Hydro Models

Breaking model plane records may seem boresome to you model enthusiasts these days when so many of them are being broken but I think most of you will get quite a thrill out of hearing of the raising of the hydro record, especially since the record was broken by a very large margin.

For years the Model Editor himself has held the World's Hydro Model record, with a model having a spruce twin push "A" frame and a pine beam tapered wing single covered. The only balsa parts on this model were the formers in the rear float and the propellers.

At the annual national contest of the Playground and Recreational Association of America at Atlantic City, Tudor Morris, of Peru, Indiana, raised the record from two minutes and fifty-two seconds to twelve minutes and thirty seconds. His model was constructed entirely of balsa wood and bamboo and he used a fairly large number of strands of rubber. In other words, his record was made possible by the use of plenty of "horse power."

The model took off from the launching pool at Bader Field and climbed to a very great height, so high in fact that it was difficult to see it except when the wing was turned with its flat surface to the observer. This great climb was made possible by the "horse power" which

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1/16"x 1"x3'		.06
1/16"x1/2"x3'	.03	.033
1/16"x1/4"x3'	.045	.054
1/4"x1/4"x3'	.054	.06
1/8"x 1"x3'		.24
1"x 3"x3'		.48
1"x 3"x3 1/2'		.56

Reed 6' lengths, 1/8" diam. .05c; 1/8" .075c; 1/4" .10c; Balsa discs 1/4" thick 2" diam. .07c; 3" .08c; 4" .09c.

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Ambroid cement, 2 oz. .33; 4 oz.	.53
Bamboo paper 13x36" .13; 24 1/2"x33 3/4"	.14
Rice paper, 18"x24, .09; 21"x25"	.06
Wood veneer, 20"x30"	.22
Flat rubber 50' of 1/8", .50; 50' of 1/4"	.75
Piano wire 3' of No. 5 or No. 8, .04; 3' of No. 11 or 15	.06
28-30-32-34 steel wire, per spool	.10
1/4" copper washers, 10 for	.05

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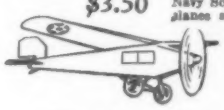

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put the model up where the excellent gliding qualities of the little plane could do their stuff. The model glided across Atlantic City and across the Board Walk and landed so far out in the Atlantic Ocean surf that it required a pair of binoculars to see it when it struck the water.

The Model Editor solicited the aid of the coast guard, with the assistance of the Atlantic City committee, and a coast guard boat was sent out. Between the coast guardsman and Virgil Rassner, who accompanied him, they finally succeeded in locating the model after considerable rowing about in the ocean.

The model was in fine condition and the Model Editor has Mr. Morris' permission to present the details of this model to the readers of the model section of Popular Aviation soon, should a sufficient number of requests for this data be received.

Mr. Morris is only seventeen years old and has only been building model airplanes for a little over a year. He reads the Model section regularly in Popular Aviation. You can see the wonderful record he has made and that it only takes a short time and a little perseverance to become an expert model builder and perhaps a world record holder.

Model Aluminum Cowlings

To Walter Brown, of West Gayville, New York, goes the credit for a very simple method of reproducing the scroll or tooling effect found upon the cowlings of large airplanes, such as the "Spirit of St. Louis."

Mr. Brown's method is to use a piece of sandpaper held over the end of the thumb and to rotate the sandpaper in one spot and then move to another spot on the aluminum and to do this in straight lines, then in rows, making the very decorative effect such as we all know so well on the silver nose of Lindy's famous Ryan plane.

The Model Editor suggests further that the method used on the large planes would not be too difficult to apply to the models. In large cowlings on large planes the method is simply to place the metal under a drill press in which is mounted a round wooden bit about the diameter of the tooling desired. On cowlings this runs from 1 inch in diameter up to 3 inches and even four inches. The rotating wooden bit is brought down upon the aluminum which has been covered with a thin layer of oil and emery powder. The cowling is moved along so that these spots show in neat uniform rows.

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Women's Aeronautic Association of California

Women flyers of California have organized themselves into the Women's Aeronautic Association of California, according to word received from Mrs. Elizabeth L. McQueen, the founder and president. The organization is incorporated not for profit, but solely to stimulate interest in aviation. The new association numbers among its honorary members Amelia Earhart, Ruth Elder, Mrs. Arthur T. Goebel, Lady Astor and Lady Allenby.

The association will sponsor air meets, airplane races, and stunt flying, and is dedicated to the promotion of safe aviation.

Aeronautical Library

(*Continued from page* 84)

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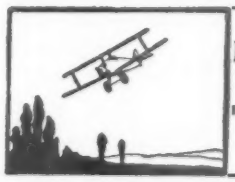

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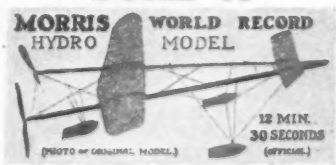

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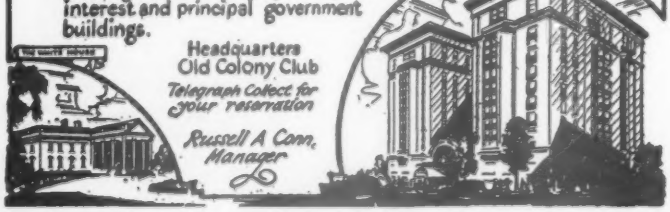

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Aviation Engines

(*Continued from page 78*)

operation in the vicinity of salt water).

d. The development of a foundry practice and the commercial application of Y alloy in cylinder head castings.

e. The investigation of valve cooling and valve materials and the development of properly proportioned salt-cooled and standard valves for air-cooled engines.

f. The vindication of the large two valve air-cooled cylinder. The Air Corps two valve "X" cylinder with 188 cubic inch displacement develops 133 pounds per square inch brake mean effective pressure at 1,800 r.p.m., approximately 166 pounds indicated mean effective pressure.

The progress made in air-cooled engines in recent years offers splendid justification for the time and money spent in research. It is a vindication of the judgment and tenacity of Charles L. Lawrance who nourished the idea in its babyhood, stayed with it during the lean years of its boyhood, and is now rightfully enjoying the phenomenal success of the Wright Whirlwind engine, which he originally developed as a Lawrance motor.

The mechanical and thermal difficulties of large power air-cooled engines are now bugaboos of the past.

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Instead of 160 horsepower, manufacturers are now building air-cooled engines in 400 and 600 horespower sizes, and the Army has had a 24-cylinder air-cooled "X" engine built by The Allison Engineering Company of Indianapolis, which is conservatively rated at 1,200 horsepower.

One of the most gratifying features of engine development in the past two years is the interest displayed in engines developed for commercial use. Nine engines, ranging from 45 to 600 horsepower have obtained certificates from the Department of Commerce, and this list does not include such proven military types as the Wright Whirlwind, and the Pratt and Whitney Wasp and Hornet.

In addition to these the Air Corps has at least 50 engine designs, mostly air-cooled, under consideration, and in various stages of development, ranging from rough drawings to finished running engines.

Engine design is rapidly coming abreast of airplane development, and, as the engine is the very heart of aerial transportation, the situation presents a very happy picture and one that gives promise of a commercial aviation development in this country that will be a model for the world.

Bureau of Aeronautics

(*Continued from page 60*)

estimated their flying totalled 30,000,000 miles in 1927, an increase of 12,000,000 miles over the year before.

Private flying for pleasure and business is growing most rapidly, scores of business concerns operating their own planes.

Air-rail co-operation has come into existence and long distance travel has been inaugurated or scheduled using fast trains at night and the airplane by day, and designers are building ever larger and more luxurious planes to accommodate passenger traffic. Airplane passage to Europe over a chain of floating airports is promised.

The value of exports in the 1927 calendar year nearly doubled the 1926 figure, while production of 70 aircraft manufacturers increased 63 percent in value and 68 percent in numbers. As 1928 draws to a close the aircraft directory lists 168 aircraft manufacturers. The industry as a whole is still behind on its orders and it is estimated that the close

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of the calendar year will see production doubled.

The reduction in the air mail rate on August 1, 1928, from 10 cents a half ounce to 5 cents an ounce as the result of legislation nearly doubled the volume of air mail over the previous month. From January, 1926, to August, 1928, inclusive, the public has increased its use of the air by 18 times.

The industry is favorably interested in uniform regulatory legislation by the states and a uniform act has been drafted which is now before the public. Seventeen states still have no aeronautic legislation. 11 states have what is known as a "uniform state law" but it is not regulatory. Eighteen states have regulatory provisions and 3 have laws which are neither "uniform" nor regulatory. The Federal Air Commerce Act prevails in all territories, in the District of Columbia and in the Canal Zone. Michigan has a "uniform state law" and a separate regulatory act.

Regulation has been firmly established and is recognized as a basic part of success in civil aeronautics. The owner of the unlicensed plane and the unlicensed pilot are finding it more and more difficult to explain the lack of licenses, even in states where legislation has not yet been enacted to require a Federal or state license to engage in intra-state air commerce. The public has begun to look for the license number before entrusting life and property in the air. States will wisely study the situation with a view to enacting needed laws which will eliminate unscrupulous operators using unsafe planes and the inexperienced or unsafe pilots who cannot qualify for licenses. It is anticipated that practically all of the States will follow the example of those that already require a federal license in order to fly within their borders.

Civil aeronautics is no longer on the threshold. It has entered into the business world and without subsidy it has become an integral part of American industry and transportation. In providing the Federal Government's contribution to this accomplishment the Department has had the confidence and co-operation of the entire industry. Notwithstanding the magnitude of the development during the past two years there is every indication of a still greater growth during the next pioneering period. It is of the utmost importance that the Department be provided with ample funds and personnel to perform the task assigned to it by the Air Commerce Act.

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Slightly used Velie motored, cabin type Monocoupe $2,500. Slightly used OX5 motored American Eagle airplane $2,250. Brand new Travelair, three place biplane equipt with $650.00 Pioneer instrument board. This is not now equipt with motor but there goes with it the drawings for an approved type of Anzani motor mounting and new 120 H.P. Anzani together with new Hamilton propeller for this motor and airplane. Altogether this cost $5,000, we are authorized to price it to you at $4,500. One slightly used JN4D airplane $975 or less motor and motor equipment $575.

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Aeronautical Instruments

(*Continued from page* 56)

Heyl-Briggs and the Pioneer instruments differ in the methods of indication used; however, both types employ null methods. That is, when the aircraft is on the course, the indicator reads zero, and deviations from the course are indicated by corresponding readings of the indicator.

At present the indicator compass is largely restricted to use in transoceanic flights, by the military services, and for experimental purposes. This has been partly due to the necessarily high cost of the instrument during its long development stage.

The development of navigation instruments bears a direct relation to the increase in endurance of airplanes. It is one thing to fly from New York to Boston on a clear day, and yet another story to fly from California to Australia with night flying and tropical storms to encounter. On a transoceanic flight some additional means of navigation must be provided to ensure arrival at the proper destination.

"Dead reckoning" consists essentially in following a predetermined course by a knowledge of the speed, direction, and time of travel of the craft. Speed, at present, cannot be determined absolutely, for no satisfactory ground speed indicator is available. However, the airspeed indicator gives a record of the speed through the air, providing corrections for air density, that is, corrections for altitude, are made. The drift meter permits wind speed to be determined if objects on the earth's surface are visible and the proper combination of airspeed and wind speed then gives the ground speed. The drift meter consists of some alignment device which may be set parallel to the apparent motion or "drift" of objects on the ground. Early forms of the drift meter consisted of rotatable rings crossed by wires, the rings being graduated in degrees, while later forms were provided with linkage mechanisms which provided for mechanical solution for wind speed. Since the war, progress has followed two main lines. With one type of drift indicator the motion of a ground object is followed by means of a telescope connected to a plotting device. Thus a "drift line" is obtained and the wind speed is obtained graphically. Another type

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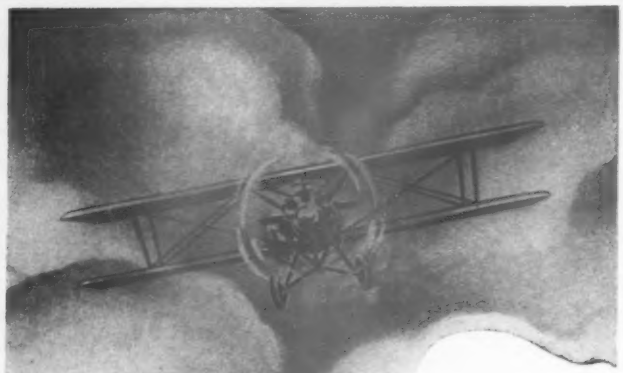

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is of very little value in the air since its use requires that the natural horizon be visible. So the artificial horizon sextant is in demand. This instrument has had a long history. Almost immediately after his invention of the sextant in the early part of the 18th century, Hadley designed an instrument with a liquid bubble level as an artificial horizon, but this found little application until airships came into being. Then from about 1895 to 1910 we find a great amount of work on artificial horizons of gyroscopic, pendulum, and liquid level types. At present the liquid level artificial horizons seem to be the favored type.

R. W. Willson in 1894 devised a special telescope containing a bubble level horizon for use on marine sextants. The optical characteristics of the combination were such that the images of both object and bubble moved in the same direction when the sextant was tipped. In a slightly modified form this instrument is still finding favor in service. Three years later Jaderin designed a sextant with similar performance, on which the bubble level was separate from the telescope and mounted in the position of the horizon mirror. About 1903 Favé devised an instrument for measuring azimuth which combined a magnetic compass and an arrangement for measuring altitudes. The part for measuring altitudes consisted of a single pivoted mirror whose angle of rotation was indicated on a scale. The bubble level was viewed directly through a collimating lens and by setting the mirror to the proper angle, the reflected image of the sun was brought to coincidence with the bubble image.

Most of the bubble level sextants of today are identical in principle with one or the other of these early models. A great deal of progress has been made, however, for the advantages of the modern instruments are apparent under the adverse conditions encountered in airplane flight. These advantages are light weight, proper balance, reduced size, electric illumination, and general provisions for ease of manipulation. One distinctly new idea is that of the camera sextant. The first model was built at the Bureau of Standards for the Bureau of Aeronautics of the Navy Department. This instrument photographs simultaneously the sun's image, the bubble image, the necessary scales and the time. From the resulting print, which is ready within a few minutes

after the observation has been made, the altitude of the sun is readily computed and the print itself forms the record of the sight. Great improvements have been made but the instrument is still in the experimental stage.

Ingenious slide rules for solving the so-called "astronomical triangle" —a problem in spherical trigonometry—have been brought out but these are being superseded by compact tables and charts, which give a rapid determination of position with a minimum of labor.

A new type of watch designed so that the second hand may be set independently in the same manner as the minute and hour hands has been evolved lately. This eliminates the necessity for making a correction for any error in the indications of the second hand. While this may seem to be a small point, it must be remembered that the airplane flies at a high speed and the position must be determined rapidly to be of any help. Sextant observations, calculations and plotting of position must be completed in a few minutes, an undertaking which demands not only great skill on the part of the navigator, but the elimination of every possible source of delay.

The performance of instruments installed on commercial airplanes is inferior for the most part to that of the best instruments which are available. The bridging of this gap is of increasing importance in the near future. The discrepancy appears to be due to inadequate provision on the part of operators of air lines for handling the purchase, installation and servicing of instruments. The instrumental equipment should be in charge of trained personnel and the necessity of frequent testing requires test apparatus. This need is being recognized; the establishment of an instrument service by one air mail contractor has recently come to our attention.

History of Naval Aviation

(*Continued from page* 34)

ticipates as a unit of the Fleet in all naval maneuvers and has become practically indispensable for the observation and correction of gunfire, performing patrol and scouting missions in addition to the offensive operations which it can carry out. On July 1st of this year the Navy had 624 modern airplanes in operation, almost half of which were actually at sea, the remainder being assigned to

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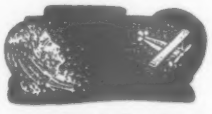

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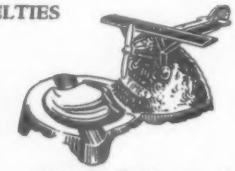

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Naval Aviation has proved beyond a doubt that it is indispensable to the Navy and to the country in general in assisting in the plans for national defense. In the matter of material and training of personnel it is not surpassed by any nation. This branch is still in its infancy, comparatively, and much more may be expected of it in the future than it has been able to accomplish in the past.

History of Army Aviation

(*Continued from page 27*)

Corps did its utmost to safeguard flying operations. In the past few years there have been only a very few cases of structural failure, indicating that, as far as the airplane itself is concerned, it is a safe vehicle in which to travel. Any idea which might lead to the development of a safety device is carefully weighed and tried.

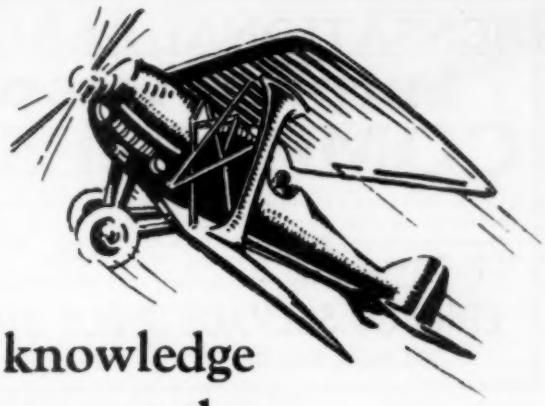
All experimental engineering work is performed at the Materiel Division of the Air Corps at Wright Field, Dayton, Ohio. This unit, then termed the Engineering Division, was established during the war at McCook Field, near Dayton. In the middle of last year this engineering plant was transferred to a much larger site, totalling 4,550 acres, located 5¼ miles northeast of Dayton. Operations at McCook Field suffered by reason of inadequacy of space, the area of the flying field being too limited to permit any extended experimental work in flight-testing airplanes. Furthermore, the proximity of the field to congested residential areas of Dayton rendered this work hazardous. The enterprising, patriotic and generous-spirited citizens of Dayton donated the new site to the Government, and the new field was dedicated on October 12, 1927, amidst impressive ceremonies. At the present time the new field is in an unfinished state, but when it is finally completed it will be the largest and finest experimental aviation

plant in the world, a fitting monument to the Wright brothers, the two pioneer airmen of Dayton, whose energy and perseverance made heavier-than-air flight possible. The experimental engineering plant of the Air Corps now goes under the name of the "Materiel Division," and is under the supervision of Brigadier-General William E. Gillmore, Assistant Chief of Air Corps.

The method employed at the Materiel Division of testing airplanes to determine their safety factor has reached such a state of perfection that the engineers in charge of that work know exactly how much stress and strain each type of airplane can withstand. Every part tending to make up the whole structure of the airplane is subjected to a severe test—alluded to as a static test—the wood, the fabric, the metal, the wires, etc. No new type of airplane is accepted by the Air Corps until it has successfully withstood all of these tests. Nothing is left to chance.

When a new airplane has emerged with a whole skin, as it were, from the "torture chamber" of the Static Test Department, it is taken up in the air by one of the expert test pilots on duty with the Flying Branch of the Materiel Division, and given another severe test to determine its behavior in actual flight. It is during these test flights that knowledge is gained as to what the airplane can and cannot do. As may well be surmised, the task of the small coterie of test pilots at Wright Field is by no means an easy one—not to mention its hazardous nature. Certain it is that they must possess piloting skill to a superlative degree.

The safeguards to flying which have been developed by the Air Corps comprise a long list, those deserving special mention being the parachute, the use of which has thus far saved the lives of 96 airmen in this country; the earth inductor compass (which helped Col. Lindbergh to pilot his "Spirit of St. Louis" unerringly to his destination); the radio beacon, used to good advantage in the several California to Hawaii flights; also landing gears; landing gear brakes to facilitate planes landing in small or restricted fields; gasoline safety tanks to minimize the fire hazard in crashes; various night landing accessories to night flying; self starters, etc. All these devices have aided in lessening the number of accidents and, as a consequence, in instilling confidence in the public mind as to the safety of aerial transportation.



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The Wright Brothers

(*Continued from page* 16)

to the brothers by General James Allen. This was the thirteenth time the nation's highest honor had been awarded for non-warlike achievements, and it was the first time in twenty years that it had been bestowed upon a civilian.

On June 29, in a new and improved machine, Orville Wright began flight tests once more at Fort Myer, Va. During the following month flights continued with great success. On July 27, with Lieutenant Frank P. Lahm as passenger, a new two-man endurance record of 1:12:40 was recorded. The government tests were passed with little difficulty, and the delivery was completed on July 30. It had been agreed that $25,000 should be paid if the machine succeeded in making a speed of 40 miles an hour, and a bonus of 10% was to be paid for each additional mile. In the 10 mile cross country flight with a passenger, in which Lieut. B. D. Foulois participated, the average speed was 42.583 m.p.h. The Wrights, therefore, actually received $30,000 for their plane and for their services in instructing two officers.

In September, Orville Wright made two new world's records, attaining an altitude of 204.3 meters at Berlin, and flying for 1:35:47 with a passenger.

In the autumn, Wilbur Wright made a notable flight over New York harbor, up the Hudson, and back, as a feature of the Hudson-Fulton celebration. A canoe had been fastened under the center section between the skids should an emergency landing be necessary.

Lieutenants Frank P. Lahm and Frederick E. Humphreys were given three hours' dual instruction apiece during October, and were then released to carry on solo flying. Lieut. Foulois also received an hour's instruction from Wilbur Wright, and half an hour from Lieut. Humphreys, finishing his flying training phreys. Lahm and Humphreys were relieved in November, and Humwithout doing further flying.

On October 15, 1909, Orville Wright concluded his flying in Germany and left for the United States. The Wright Company was incorporated on November 22, with a capital stock of $1,000,000. Wilbur Wright was president, Orville Wright and Andrew Freedman were vice-presidents, and Alpheus S. Barnes was

secretary. The Wrights, Russell A. Alger, August Belmont, Edward J. Berwind, Howard Gould, Morton F. Plant, Allen A. Ryan, Theodore P. Shontz, R. J. Collier, Andrew Freedman, Cornelius Vanderbilt, and P. W. Williamson were directors.

The Wright Brothers subsequently bought back all the outstanding stock at the original price and regained control of the company. In the meantime the firm had earned dividends so that the original stockholders made a profit on their investment. A new group of capitalists next acquired the company, and in 1916 it was consolidated with the Glenn L. Martin Company and the Simplex Automobile Company. The Wrights had already withdrawn, and Martin broke his connection to form his own company not long afterward. The original Wright concern changed hands once more and finally turned to the manufacture of engines exclusively, as the present Wright Aeronautical Corporation.

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Financial Survey

(*Continued from page 98*)

Claude United States patents. It sells nothing, but manufactures and leases illuminating signs which are now seen on almost every business block of almost every sizable city in the country and are rapidly displacing the old fashioned electrical bulbs. Glass tubes, constituting the letters of the signs, are filled with Neon Gas (one of the rarer constituents of the air) and this gas is electrically excited and the resultant light resembles the intense red glow of sunset. Other colors than red, such as blue, green and purple, are now available. These signs are usually leased for a minimum period of 36 months. Some users are paying in excess of $5,000 a month. The ownership of the sign is invested generally in a local licensee company, which maintains the service of the business concern using this form of advertising. It is claimed the cost to the user is about 60% of what he would pay with the old style electrical bulb.

Claude Neon tubes have been especially adapted to the aviation industry for beacons and for marking and outlining airdromes and airports in many parts of the world. The great landing field at Croydon, England, has used this form of illumination since 1924, and Neon lighting is now making rapid headway in this country, Canada, and South America, as this light has a special significance, owing to its visibility through a deep fog. The Standard Oil Company of California is making an adaptation for all of their gasoline stations throughout the Pacific Coast, from Mexico to San Francisco and north from Portland to Seattle.

The largest electric sign in the world is illuminated with Claude Neon tubes. This is on the hills overlooking Portland, Oregon, and consists of the word "RICHFIELD." The letters are 60 feet high, and the sign is over 725 feet in length.

Claude Neon Lights, Incorporated, is a holding company having a substantial stock interest in about twenty subsidiary licensees located in California, Florida, and in the following cities: Chicago, Detroit, Pittsburgh, Boston, Atlanta, Philadelphia, with many additional plants being rapidily planned. The holding company's ownership in common stock of subsidiaries (which, it is reported, averages around 25%) is carried on the books, we are informed, at $1.00, yet one of these subsidiary companies has 6,250 shares, with a present market price at $185 a share, or $1,156,250. It is difficult to get a definite statement of earnings, as the company has not published its affairs to the public. Net profits and surplus were reported on November 30th, 1927, as $2,597,072, after deducting approximately $800,000 for certain reserves. One licensee, operating with headquarters in Chicago, reports $1,000,000 of business in the first nine months of this year. We are unofficially advised that 25% represents the approximate net profit on sales.

Claude Neon Lights, Incorporated, has only $50,000 of preferred stock, outstanding on which dividend requirements are $3,500. The balance applies to 91,000 shares of common. In view of the overwhelming progress that has already been recorded in such a short space of time, and the revenue continuing to increase at a remarkable rate, an earning power of $100 a share is not an unbelievable expectation, according to trade channels and several banking firms that are close to the company's affairs. Stock is traded "over the counter," in a number of the larger cities throughout the country.

Common stock originally issued at 10, sold at 25 in February, 1928, was wanted at 150 a few weeks ago, and sold at 276 on October 27th. The market has been a rapidly changing one, and it is useless to try to gauge how far this company and its securities may be expected to advance.

The Fokker Aircraft Corporation has been reorganized. The outstanding points are these: The company redeemed its 20,000 second preferred, which was practically all owned by Anthony Fokker, and gave in lieu thereof five shares of the new common for each one of the second preferred. It increased its former common capital from 105,000 shares to an authorized amount of 1,000,000 shares. The present financial structure is 40,000 shares of first preferred outstanding, and 480,000 shares of common outstanding.

Mr. Talbot, vice-president of the Richfield Oil Company, is chairman of the board, and Mr. Hanshue, chief executive of the Western Air Express, is president. The latter is regarded as one of the best operating men in the entire United States and has made a very signal success of the transport and mail carrying company that operates between Salt Lake City and Los Angeles. Officials of the Richfield Oil Company are reported to have bought 200,000 shares of the new common stock.

The proceeds of the new financing will be used partially to install a new plant on the Pacific Coast that will confine its operations entirely to the manufacture of the Amphibian planes, and smaller craft. The plant at Wheeling, West Virginia,

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will continue to manufacture the larger commercial craft.

The Packard Motor Company still continues to be in the limelight in the aeronautical field. Besides having developed a Diesel engine that we are informed has been very successfully tried out in an experimental way in a Stinson plane the company, through Captain Woollson, chief aeronautical engineer, has scored with a new 24-cylinder engine, showing 1500 h.p. on the block. This has 24 cylinders and was built with the United States navy especially in mind. It is expected to propel an airplane at more than 350 miles per hour.

If any potential investor in aeronautical securities has any doubts about aircraft sales mounting, his attitude should be changed by the report of the September sales of the Chance Vought Corporation, which amounted to $410,000. This is a record.

Evidence that the very conservative financial element has allied itself with aviation can be gathered from two statements appearing in financial papers of this week. One gives the details of the purchase by the National City Bank of New York, of a $5,000,000 interest in the Boeing Transport Corporation, and the other records the entrance of Otto H. Kahn, of Kuhn, Loeb & Company, and some of the Dupont interests into the recent reorganization of Bellanca Aircraft.

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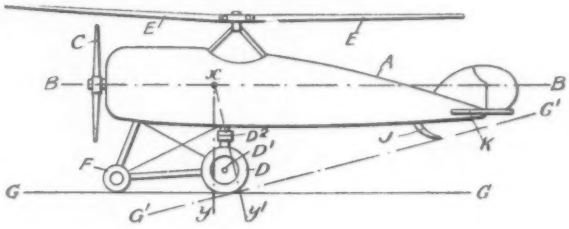
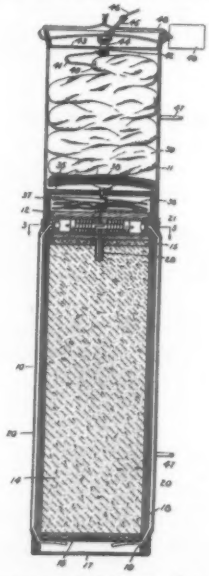
No. 1,682,893, AIRCRAFT WITH ROTATIVE WINGS, and Patent No. 1,682,894, UNDER CARRIAGE OR LANDING GEAR FOR AIRCRAFT, Patented September 4, 1928, by Juan de la Cierva of Madrid, Spain.



These two patents relate to the gyro airship which the inventor de la Cierva successfully flew across the English Channel and in addition to these two patents two previous patents Nos. 1,590,497 and 1,678,935 have been obtained in the United States. The general characteristics of the machine disclosed in these patents is widely known through newspaper and magazine articles in the past. The Spanish Embassy at Washington states that the inventor expects to visit this country within the next two months.

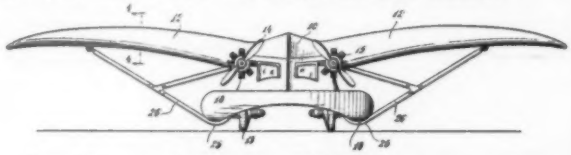
No. 1,683,939 and 1,683,940, AEROPLANE FLARE OR SIGNAL AND ILLUMINATING MEANS THEREFOR, Patented September 11, 1928, by Samuel Wiley of Metuchen, New Jersey.



These patents were granted on the same day to the same inventor and provide improvements in a flare or signal without a separate shipping container; adapted to be carried within the fuselage of the plane to avoid

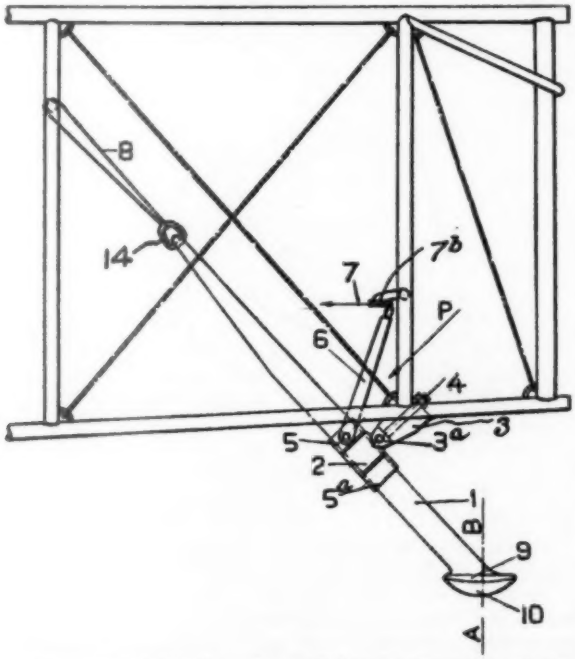
wind resistance and releasable through the floor of the plane. It is capable of positive ignition when released with a parachute but incapable of ignition within the plane.

No. 1,683,805, AIRPLANE, Patented September 11, 1928, by Bruno Reichelt of Nutley, New Jersey.



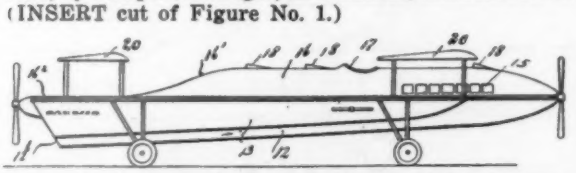
Provides an airplane in which a pontoon or floatation means is provided that permits the airplane to safely alight on water, and to remain afloat thereon as long as may be desired, and to easily take off therefrom without interference or hindrance by the water.

No. 1,683,965, TAIL SHAFT FOR AIRCRAFT, Patented September 11, 1928, by Anthony Herman Gerard Fokker of Amsterdam, Netherlands, Assignor to Atlantic Aircraft Corporation of Hasbrouck Heights, New Jersey, a Corporation of New Jersey.



A patent granted to the well known inventor of the Fokker airplane, the general object of the invention being to overcome the inherent weaknesses of previous efforts to solve the problem of directional control of an airplane when traversing the ground, through the medium of the tail supporting shaft, in a simple, economical and efficient manner.

No. 1,684,087, AEROPLANE, Patented September 11, 1928, by Joseph Carl Elger, of Pittsfield, Massachusetts. (INSERT cut of Figure No. 1.)



A radical change in aircraft design which the patentee claims will facilitate the forward propulsion thereof, eliminate the tendency of the airplane to tilt

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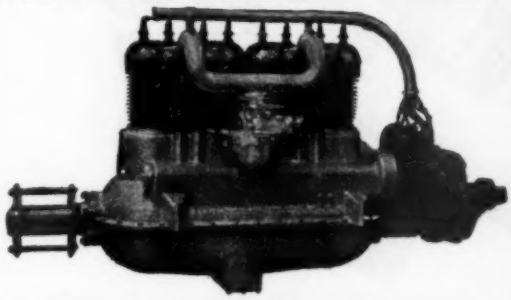

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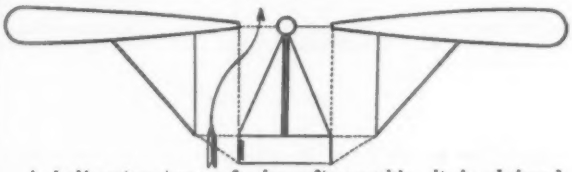
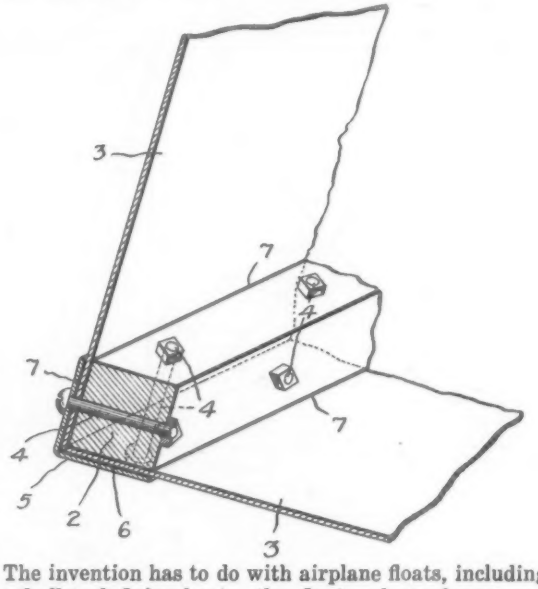
sideways, aid in retaining the equilibrium when the driving power ceases, facilitating gliding or soaring in the air and assuring safe landing.

No. 1,684,163, FLYING MACHINE, Patented September 11, 1928, by Paul Valentin of Paris, France, Assignor to Rene Dreux of Paris, France.



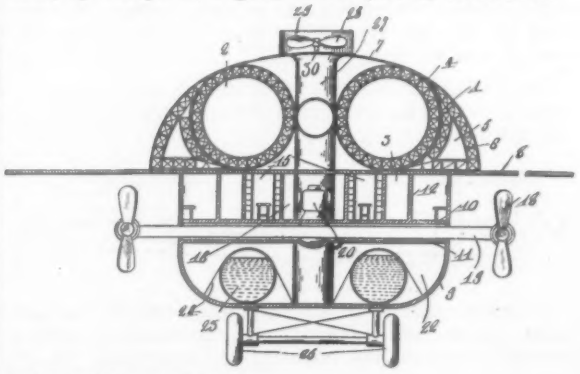
A helicopter type of aircraft capable, it is claimed, of performing evolutions under effectively and constantly safe conditions. The apparatus is provided with a single elevating and gliding screw and a fuselage in the form of an inverted truncated cone.

No. 1,684,187, CONSTRUCTION FOR AIRPLANE FLOATS, Patented September 11, 1928, by Grover Loening of New York, New York.



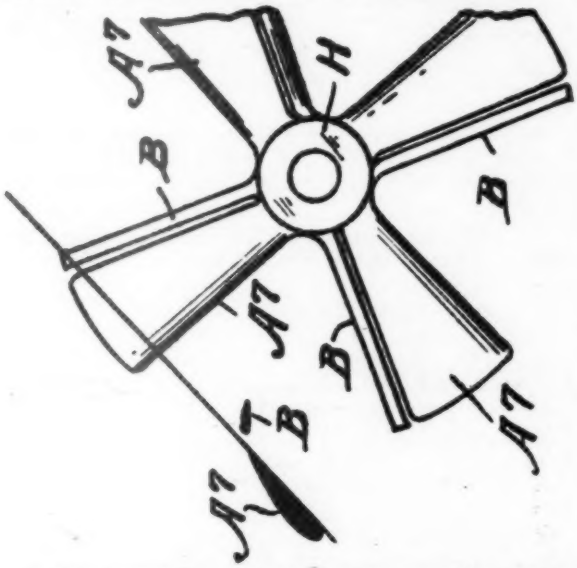
The invention has to do with airplane floats, including the hulls of flying-boats, the floats of seaplanes, and wing pontoons. The invention has for its object a composite wood and metal construction for such floats, possessing advantages over prior all-metal or all-wood floats, and a special object is to avoid corrosion in such a construction.

No. 1,684,240, AERONAUTICS, Patented September 11, 1928, by Joseph E. Pigeon of Hollywood, California.



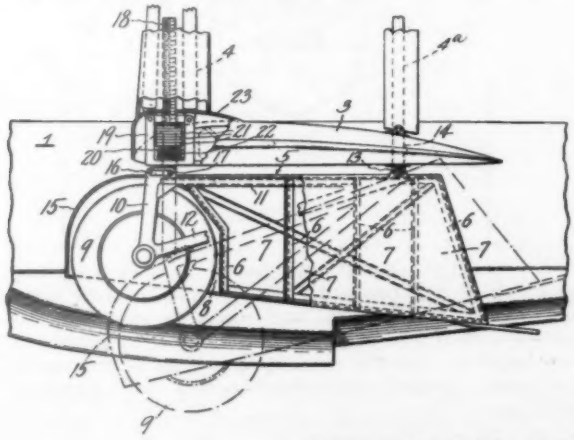
A combination of the theories of construction used in both a lighter than air and a heavier than air aircraft. The body construction is such that the craft may be advantageously used for commercial purposes, the storage space being so disposed that the added weight of fuel, etc., will give an extremely low center of gravity to the airship and thereby assist the stabilizing and flight thereof.

No. 1,684,567, PROPELLER, Patented September 18, 1928, by Charles Arthur Wragg of Washington, District of Columbia, Assignor of one-half to Louis H. Crook of Washington, District of Columbia.



In this propeller a main blade and an auxiliary blade compounded to form a single unit is provided. The patentee states that he has discovered and proved by a long series of tests that if a small auxiliary blade is introduced into or near the region of turbulence or cavitation the effect is to reduce the loss of energy in eddies over the whole of the compounded blades and to result in greater overall efficiency. The inventor does not claim that the number of so-called eddies will necessarily be reduced but that the sum total of energy losses however expressed will be reduced in actual quantity.

No. 1,684,818, RETRACTIBLE FLOAT FOR FLYING BOATS, Patented September 18, 1928, by Vincent J. Burnelli of New York, New York.



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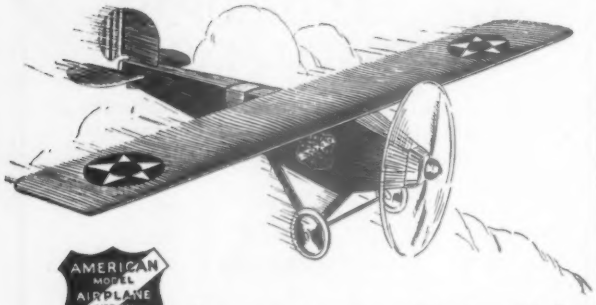

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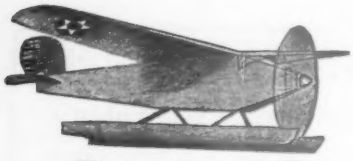

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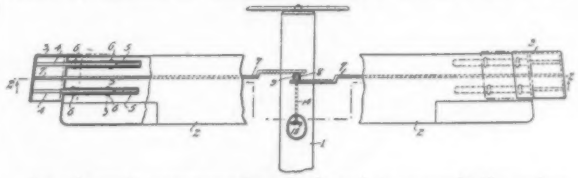
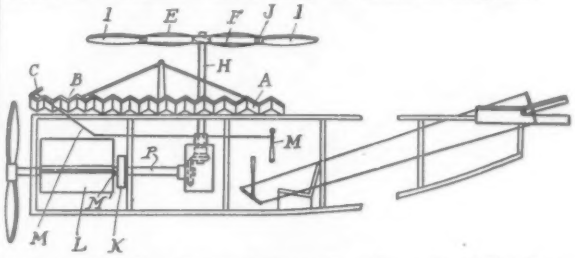
This invention relates to flying boats such as are provided with stabilizing floats pendent from wings and the improvements are directed to means for mounting a traction wheel on each of the floats, for land service, together with means for adjusting said floats vertically, whereby the wheels may be lowered for land service and raised when the craft is in flight or floating on water.

No. 1,685,014, AIRCRAFT, Patented September 18, 1928, by Abram A. Anderson of New York, New York.



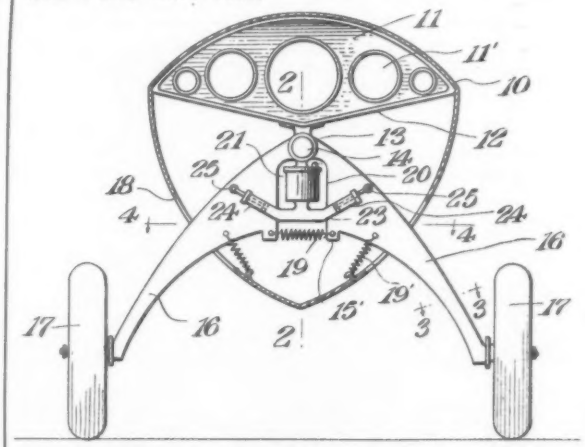
An aircraft construction designed to permit the wing surfaces to be extended for facilitating take-off and retracted in flight so as to facilitate manipulation of the ship.

No. 1,685,029, AIRCRAFT, Patented September 18, 1928, by Thomas Daniel Kelly of London, England.



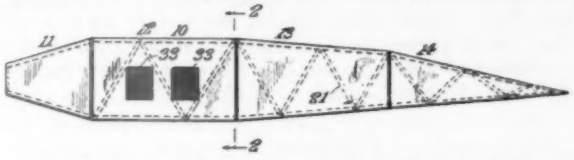
A combination type of aircraft, primarily of the helicopter type but comprising both rotating wings and stationary planes with pockets to create a partial vacuum. In addition to this United States patent the patentee has obtained British Patents Nos. 101,442 and 111,128.

No. 1,685,119, LANDING GEAR FOR FLYING MACHINES, Patented September 25, 1928, by Edmund B. Carns of New York, New York.



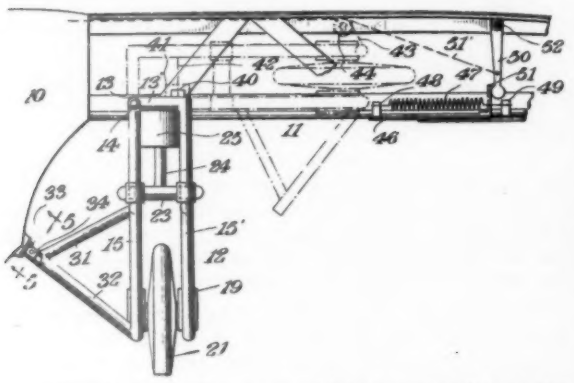
An invention that is intended to produce a landing gear which will resiliently support the fuselage when running on the ground, and which is pivotally connected with the fuselage above the center of gravity of the latter so that the running gear may be traversing an uneven surface but the fuselage will swing to a level position.

No. 1,685,121, FUSELAGE, Patented September 25, 1928, by Edmund B. Carns of New York, New York.



A fuselage which can be conveniently constructed in longitudinal separable sections, and with these sections constructed so that they can easily unite in a manner to make the body, as a whole, as rigid as if it were not sectional.

No. 1,685,122, AIRCRAFT CHASSIS, Patented September 25, 1928, by Edmund B. Carns of New York, New York.



A chassis or landing gear which is suspended on the wing and which is adapted to swing upward to the wing when the machine is in the air so as to avoid unnecessary air resistance. Special means are provided for swinging and releasing the attachment so that it may be done easily and rapidly.

No. 1,685,422, PARACHUTE, patented September 25, 1928, by Dane Hurlburt of Cannes, France.

A parachute designed to permit the operator to cause a side-slip of the parachute at any time during its

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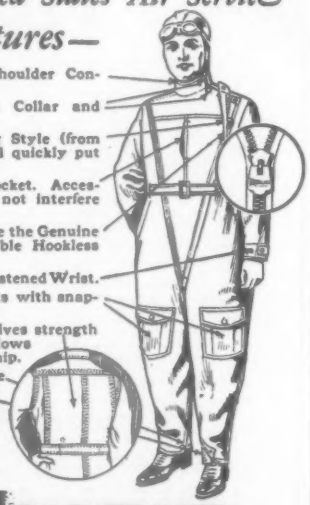

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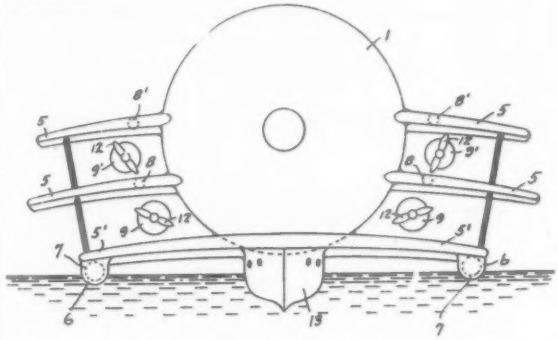
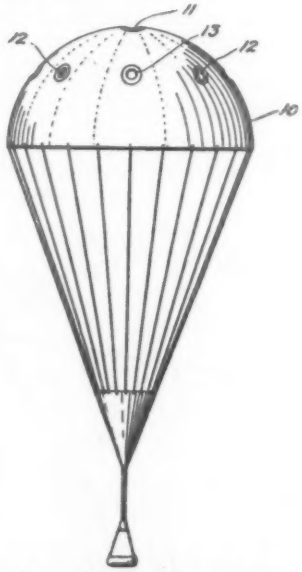
descent, means being provided to turn the parachute on its vertical axis in either direction so as to control the direction of the slip. The attachment for accomplishing these results adds little to the weight or bulk of the folded parachute and enables the operator easily to glide a considerable distance in any desired direction and thus to avoid dangerous landings.

No. 1,685,458, AIRCRAFT, Patented September 25, 1928, by Leonard P. Lidback of Honolulu, Territory of Hawaii.



An airship that combines the lighter-than-air craft principle with the heavier-than-air craft principle. The device employs a gas containing bag having a great lifting power, and a plurality of airplane wings that aid in lifting the airship, and in keeping it on an even keel when the ship is flying through the air.

No. 1,685,688, PARACHUTE, Patented September 25, 1928, by Axel Raoul Thornblad of Stockholm, Sweden, Assignor to Aktiebolaget Fallskarm of Stockholm, Sweden, a Corporation.



The present invention has for its object to provide means for decreasing the vacuum arising on the upper side of the body portion on descending with the parachute in order to insure a reliable decrease of the shock which arises when the parachute opens.

Readers of Popular Aviation may secure complete copies of any of the above patents at the rate of twenty-five cents each. Remittance should be included with the order and sent to Popular Aviation, Ouray Building, 805 G St., N. W., Washington, D. C.

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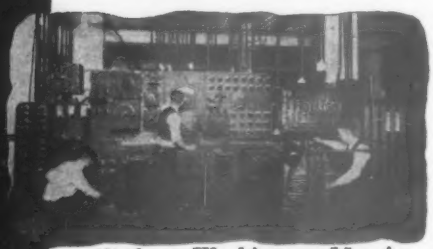

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